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Anaconda's Mapping Practice

How the surveying records of a large mining company are kept orderly and accessible

By J. L. Hayes

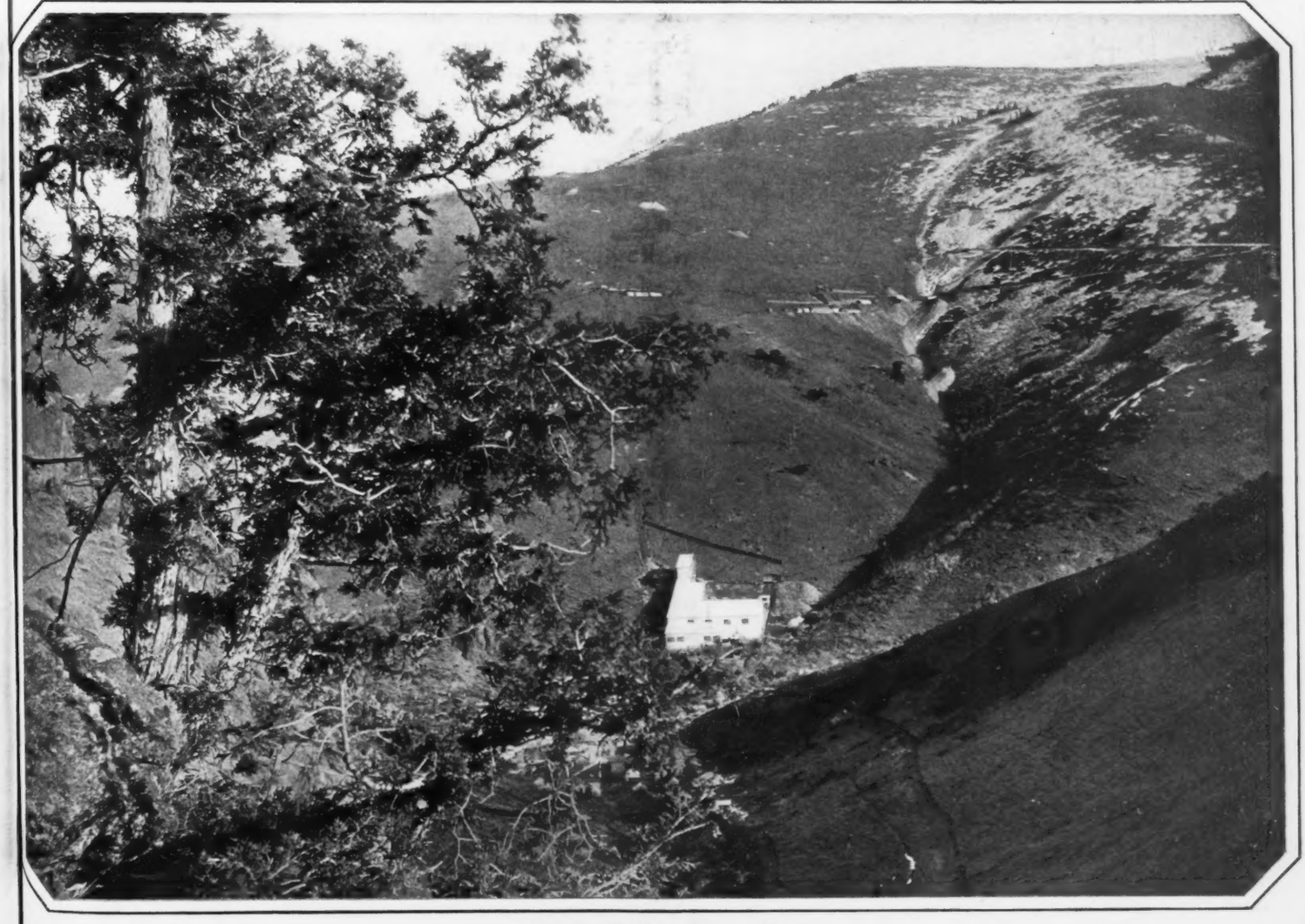
Free-milling Gold Ores of Japan

By H. Nishihara

Minnesota's New Ore-testing Laboratory

By Arthur B. Parsons

Biography of FRANK C. WALLOWER, *President of the American Zinc Institute*



At Jarbidge, Nevada

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Looking down past Burch Grizzly into crusher

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ENGINEERING & MINING
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Rails and the Metals

THE RAILROADS of the United States have long been a popular target for disgruntled farmers and business men to shoot at. When the farmer wants relief from low grain prices he begins to hammer rail rates; when consumers, industrial and otherwise, want cheaper coal, they ask for a cut in freight charges. Metal miners have not been immune from this practice and have had justification frequently for making complaint against the roads, but they have not occupied so conspicuous position as agricultural interests in trying to make the railroads reduce their carrying tariffs. Of course, reductions are often warranted and necessary, and we do not wish to pose as a defender of the rails for any tariff they may deem appropriate. But there is this much to consider: At the present time the railroads are far from prosperous. A few isolated examples may be cited of some that are earning splendid returns, but that does not apply to the roads as a whole. The low quotations of railroad shares on the New York Stock Exchange are a sufficient indication that the transportation systems of the country are not so prosperous as they were before the war. But what has all this to do with the metal-mining industries?

In the first place the railroads represent in the aggregate an enormous purchasing power. The supplies that a well-equipped railroad needs are almost limitless. They range from those required for track and rolling stock to those used in stationary equipment. Although iron and steel are the most important metallic commodities consumed, the roads are often in the market for lead and use many articles made of copper and brass. Electrified railroads obviously use more copper in initial construction and maintenance than those of the ordinary steam type. Owing to the poor financial position of most railroads, however, they have not the buying power they should have. In the 90's, at the time of a serious panic and industrial depression, Harriman came into the market for millions of dollars' worth of railroad equipment for the road of which he was chief executive, and this action established such confidence in industry that business took an upward turn soon thereafter.

When we survey the electric railway field the situation is still worse, and we don't have to go far afield to do our surveying. In New York, the street railways generally run dilapidated cars that rattle along and look for all the world as if they would fall to pieces any minute. No new subways are being built, though sorely needed. Congestion in subway cars during rush hours is worse than that in a cage "goin' off shif.'" If any of the city railways have lately bought any new equipment they carefully keep it in hiding. It is not necessary to go further into the field of railway economics than to point out that a great market for the non-ferrous and ferrous metals is in bad condition at the moment, and that if some way were found of improving it the copper market, lead market, and others would be helped.

It is not in our province to offer a solution or suggestions as to how the railroads may be assisted and once again become *growing* enterprises, but we do wish to emphasize the community of interest between the non-ferrous metal markets and the rails. The interest of the copper producer is bound up with the interest of an important customer—the railroads. When the customer starves he cannot be expected to be a satisfactory outlet for the goods of the producer.

The St. Joe-Federal Lead Rearrangement

THE MOST IMPORTANT NEWS of recent weeks in mining circles was the realignment of lead-producing interests in Missouri. As has been reported in our news columns, the St. Joseph Lead Co. has purchased the mines and concentrating plants of the Federal Lead Co., an A. S. & R. subsidiary, and has contracted with the A. S. & R. to smelt two-thirds of the entire output. This will undoubtedly result in marked economies for both companies. The lead-mining district around Flat River has been broken up by the competing companies having small tracts that are not accessible, in some instances being entirely surrounded by the properties of the other company. For this reason they have not been proved with the diamond drill to any extent, or, where the ore in known to exist, have not been mined. Most of the district, aside from the properties controlled by the National Lead Co. and the Desloge Consolidated Lead Co., can now be developed and mined without regard to boundary lines; the ore can go to the mill most favorably situated to handle it. The modern power plant of the St. Joseph Lead Co. can also be used to better advantage. The administrative expense should also be less.

As far as smelting goes, the advantage is all with the A. S. & R., and the rearrangement is in line with the general policy of that company to forego mining and to confine its activities to the fields embodied in its name. It is said that the idea originated with Rudolph Porter, manager of the Federal smelter at Alton, Ill., about three years ago. It took some time to convince all parties to the agreement that it was desirable. Certainly it was favorable to Mr. Porter, for it means a considerable addition to his tonnage. In fact, it is planned to double the capacity of the Federal plant, and by the middle of next year it will have a capacity of twelve to fifteen thousand tons of lead a month, which will be equaled by no other plant in the world. Fourteen Newnam hearths will be added, an enlarged blast furnace or two, additional sintering capacity, a better charging scheme, new flues, an enlarged refinery, with possibly a Parkes process plant, and one of the ingenious new molding and loading devices recently perfected by Mr. Newnam. Smelting costs, which are

already thought to be lower than those at the St. Joe smelter at Herculaneum, should be still further reduced.

Smelting at Herculaneum in recent years has not been altogether satisfactory, and it is the general opinion in the district that sintering of the entire charge in D. & L. machines, followed by blast-furnace smelting, is not so well adapted to treating the Missouri concentrates as the practice at Federal. There, ore hearths are used for all table concentrates, and a double sintering is effected in D. & L. machines and H. & H. pots for the lower-grade material. It is said that the use of ore hearths has made possible a smelting charge of $2 to $2.50 less a ton, despite the hand labor, which is piece work. L. M. Warner, the new superintendent at Herculaneum, through his previous experience with the Dwight-Lloyd company and in Australia, has a thorough understanding of the equipment at his command and believes that, given the tonnage, he could smelt as cheap as, or cheaper than, Federal, but Fate seems to have denied him the opportunity. In fact, it would not be surprising, in a year or two, to see all the concentrates going to Federal and the entire Herculaneum project abandoned. It is an extremely well-built plant, with up-to-date equipment, and a whole company town is dependent upon it; it will be regrettable if it cannot be saved.

It is understood that the new order of things involves no great rearrangement of personnel. The smelting company will transfer such men as it wishes to retain, to other properties. Others will be retained, so far as possible, by the St. Joe company. The new mill of the Federal company at Elvins, which has not been in operation for two or three years, will be started immediately, and production will be speeded up generally in the district.

Where the Mine Is

OUR READERS every now and then plead for more frequent descriptions of ore deposits and their relations. "Personally," writes one correspondent from England, for example, "I would like to see every week a clear exposition of the lode structure and other geological conditions in some well-known mine. It seems to me there is a tendency among mining engineers and mining institutes nowadays to forget that, after all, the mine is underground, and not situated somewhere in the top works or in the reduction plants."

We agree with our writers that the mine is underground: that we have a tendency to overlook this fact in our concern as to how the mine shall be operated, the ore reduced, the metal marketed. We have tried, moreover, to present, from time to time, authoritative articles dealing with the real "mine"—the ore and its characteristics of lie and extension—its form, mass, interruptions, relationships, and origins. We shall try to do this in the future. The fact is that the science of the ore underground is not yet on quite such a firm and intelligible footing as the science of the other departments of a mining enterprise. Contributors are apt to be too ignorant or too pedantic, too imaginative or too stupid. In time this will, we hope, be remedied. In the meantime we shall be glad to consider contributions as to underground geological conditions, which are addressed to the common sense of the miner and are closely based upon facts.

Employee Representation

THE RELATION of employer to employee, sometimes falsely termed the relation of Capital to Labor, is a problem second to none in this country. But for a conflict between the two groups we should not have had the recurrent coal strikes, the foul and unpunished murders of Herrin, the murmur of red revolution. Therefore when a great corporation announces that it has solved the problem, all should give close attention—especially when the corporation is that acme of conservatism and respectability, the Pennsylvania Railroad. Its vice-president, Elisha Lee, in an address on Oct. 31 in New York, before the American Management Association, announced, "We feel that there should be in the future no cause for strike or lock-out in our service. There is no problem in employee relations that cannot be solved across the table under the agreements we have with our men." How? Simple, but astoundingly radical, at first glance. "We have, in the last three years, put in effect a comprehensive plan, the keystone of which is a joint committee for each general class of employees, which is the highest authority on the railroad in the determination of all questions affecting wages, working conditions, discipline, and discharge of employees. These committees are composed of an equal number of representatives of the employees, elected by secret ballot, and of the management. A two-thirds vote of the committee is necessary to a decision on any question. If this two-thirds vote cannot be had, the committee itself decides how a final determination shall be reached. No executive officer of the company, or the board of directors even, has veto power over the decisions of these joint committees."

If anyone should arise and propose such a plan to the average corporation, he would be looked upon as dangerous. But the staid Pennsylvania Railroad has been initiating these changes, gradually, for years. "We are passing through," said Mr. Lee, "an era of big things—we are living in an age of changing viewpoints. Many who have witnessed the transformation which has taken place in industrial relations within the past ten years have oft-times, I doubt not, had a feeling of awe that such things were possible and had really come to pass. The old *laissez-faire* relationship between management and men in industry is passing out, I believe, never to return."

This man talks like a labor leader, almost; and if we are to credit his statements, his employees think like railroad owners, almost. How has the thing worked out? Mr. Lee says, "Withal there has developed a deeper-rooted feeling of respect for the officer on the part of the employee, and as well for the employee by the officer. And out of this mutual respect better *esprit de corps* prevails than under previous methods. One of our officers, a superintendent, who has had many years' experience as an officer of the company under the old regime, and who now meets committees regularly each month in accordance with the plan set up, when asked recently whether he would welcome a return of the old order, declared emphatically that under no circumstances would he want to return to the old order or relationship existing between employer and employee. He pointed out that never in all his many years' service as an officer had he ever experienced such willingness to co-operate, or such actual co-operation between men and management, as was taking place today under our

employee representation plan. He stated he hoped he would never go back to the old order, that men knew their officers better today, that officers knew their men better, and that they had more tolerance of each other's viewpoints, more sympathy for each other's problems, because management was acquainting the employees with their problems, and vice versa, and out of it all was growing a bond of unified friendly understanding such as had never before existed.

"This statement is typical, and experience is disclosing that the employee representation plan has not weakened in the least degree the supervising control of the officers over the men they supervised, but on the contrary has strengthened that control, because the employees have been brought face to face with managerial problems such as they never dreamed existed—problems that they now recognize have to be met and solved by management; consequently their respect for management has increased as they have come to know that such problems not alone concern management success but employee happiness as well."

In mutual warfare there is no prospect of peace and prosperity. That applies to the relation of employer to employee as well as it does to the unhappy nations of Europe. A United States of America spells peace, prosperity, and happiness. Capital and labor, employer and employee, will thrive best only when they work together in just and close partnership. There should be no privileged classes in the modern world—what special privileges capital has filched, or labor has commandeered, should be surrendered for the common good, and will be, if the right spirit prevails. Greed will bring down the ruin of civilization. Fair play will advance civilization and speed evolution to a higher plane of life.

"But these expedients," you say, "are only applicable to great corporations like the Pennsylvania Railroad." It would be an interesting experiment to try to see whether or not they would apply to your business, if it is such that you have any interest in the matter. In our opinion the miracle is already worked; the airship is invented. Is it of any use to you?

Creditable Leadership

WE REGRET deeply the necessity for recording in our news recently the death of four men in the mine of the Utah-Apex company at Bingham, Utah. There is, however, one feature of the affair that we are glad to be able to point out: both the superintendent of the mine, Joseph Norden, and the mine foreman, Dan Eden, were working with the miners who were caught by the falling rock and timber. The superintendent was rescued after many hours' work, but his foreman was one of the four who lost their lives. The timbers, so we gather from the news account, began to take weight on Monday, Oct. 15, and a force of timber men was immediately assigned to the delicate task of "catching-up" the ground and reinforcing the supporting timbers. Work continued all night and all the next day, the fall coming just at the end of the day shift on Tuesday.

Whether any censure is due the foreman and superintendent for negligence, in allowing a large stope 70 by 70 ft., to get into bad condition, is more than we can say. We know that heavy ground sometimes falls in spite of every reasonable measure of safety. Filling, even when carefully placed, sometimes shrinks enough to let a movement get under way, and when hundreds of tons of rock begin to settle the force is tremendous. We neither condemn nor exonerate; but we do say that it is eminently to the credit of those in charge that they went with the men who had to do the work. They did not send the miners to take a risk that they themselves were unwilling to assume.

Coincidence of Research Results in Mine Ventilation

IN THE JUNE 10, 1922, issue of the *Engineering and Mining Journal-Press*, Prof. Walter S. Weeks, Wesley P. Goss, and George H. Warren published a paper detailing the results of their research on "Friction Factors in Ventilating Pipe." In July, 1923, G. E. McElroy and A. S. Richardson published the results of their "Experiments on Fan-pipe Installations at Butte, Mont.," in Serial No. 2,509, U. S. Bureau of Mines. In the latter publication the authors state that their experiments were carried out in the fall and winter of 1922-23.

We note that the Bureau of Mines experimenters have adopted the term "friction factor," which was suggested by Professor Weeks. Professor Weeks states that the factor K used in the basic formula for ventilation, $P = \frac{KSV^2}{A}$, is in reality a factor involving the density of the air. The Bureau's experimenters state: "In this formula the factor K is really another factor, designated as C, multiplied by the density of air."

The Bureau's publication states that, "Taking into account the variations in conditions between the lines tested and the lines found in operation in mines, a reasonable factor to be used in calculations for drop in pressure in sheet-metal pipe line for given amounts of air flow would be about 0.000,000,002. This is approximately the factor used in the construction of the chart printed in the American Blower company's bulletin, "Fan Testing," which is a most convenient chart for quickly determining required pressures."

Professor Weeks and his confrères state: "The factor used in the American Blower company's formula is 100,000 times the factor K used in this paper. The k used in the building of the A.B.C. chart was 0.0002. This factor would be 0.000,000,002 if used in our formula. Comparing this with K for steel pipe, it is seen that the factor used in the chart is about 33 per cent higher than is shown by our experiments. Considering the fact that the pipe used in our experiments was in excellent condition, this does not seem an unreasonable allowance for less favorable conditions."

In addition, the Bureau's publication states that for pipe lines in good condition a factor of 0.000,000,0015 would be sufficient; for canvas pipes a factor of not less than 0.000,000,0025 is advised. Professor Weeks' experiments indicate an average factor K for metal pipe of 0.000,000,0015 and a factor for canvas pipes of 1.36 times the factor for metal pipe. This would give a factor K equal to 0.000,000,002.

It is a matter of interest to record the close agreement of the two groups of experimenters. Laboratory results carefully carried out were corroborated by the more elaborate mine experiments of later date.

Mining Engineers of Note

FRANK C. WALLOWER

THE YEAR following the outbreak of the World War marked the beginning of the most dramatic deflation of any mining camp in mining history—that of the old sheet-ground district in the Joplin field—and among those who answered the call to the new, richer section in Oklahoma and Kansas was Frank C. Wallower, now president of the American Zinc Institute. Associated with his brothers, he acquired 320 acres of leases in the Picher, Okla., camp, and the Golden Rod Mining & Smelting Corporation was formed. From the first he managed this project, wherein a large acreage of practically undeveloped leases has been transformed into a splendidly producing property, equipped with three concentrators provided with the latest modern apparatus for maximum milling efficiency, each of which is capable of milling 75 tons of rock per hour. Mr. Wallower always has been deeply interested in the humanitarian side of the problem of mine management. He was interested in the Mine Safety and Sanitation Association, organized about a decade ago in the Carterville district, which functioned effectively in establishing hospital facilities in the mining field and in working out problems of mine ventilation, good roads, and welfare among the men. In the Picher camp he was one of the organizers of the Tri-State Association, which was made a chapter of the American Zinc Institute upon the organization of the latter in 1918. He was also one of the first directors of the Zinc Institute, and has been actively identified with it since its creation, his interest and efforts being responsible for his election to the presidency at the annual meeting at St. Louis last May. Mr. Wallower is a student of the zinc industry as a whole, rather than of the mining department exclusively, and has a deep appreciation of the problems of the zinc smelterman and manufacturer. He has important interests in this district besides mining, and is looked upon as a man of broad business understanding. Personally, he is kindly, thoughtful, and entirely lacking of the old-time boss's slave-driving characteristics. His inner office and his friendly attention are ever at command of the humblest of his workers, and many of the men who began working for him when he first came to Joplin are still his loyal employees. His standing as a business man and as a citizen in the Tri-State field could scarcely be higher, and his selection as president of the American Zinc Institute was accepted in his home community as a well-deserved honor. The Joplin mine of a generation ago was small in tonnage, methods of breaking ground were primitive, and milling processes were established according to precedent and example, rather than from study of metallurgical principles. Today the mill in this field has a complicated flow sheet, varying according to the character of the ore handled, and is equipped with apparatus that would make the old-time operator feel like Rip Van Winkle could he but return. The operator today in the Joplin field, who would be successful, must be more fully equipped than the operator of fifteen or twenty years ago; he must combine mining and mechanical engineering knowledge with organization ability and business common sense—and it is to this class that Mr. Wallower belongs, by training and practical experience. Mr. Wallower was born in Harrisburg, Pa., Aug. 23, 1882, and received his preparatory school training at Lawrenceville. He was graduated from Princeton in 1903, having taken the civil engineering course, and after two more years of study was given the degree of E.M. by the Columbia School of Mines. He also received the degree of Master of Arts of Metallurgy, having prepared, under the late Professor Howe, a treatise for this degree on "The Characteristics of Low Carbon Steel." Upon leaving Columbia, Mr. Wallower came to the Joplin district. At first he managed properties in the old field in and around Webb City, some of which were typical Joplin deposits and others strictly sheet-ground propositions. During the ten years from 1905 to 1915 the maximum average output from the Joplin district was 5,500 tons of zinc concentrates per week, and mills were considered to be doing well when they made in six days what some of the Oklahoma mills now produce in a single day.

FRANK C. WALLOWER

Anaconda Copper Mining Co.'s Mapping Practice

How Drawings Covering Extensive Mine Workings Are Standardized—The Co-ordinate System Used and the Method of Indexing

By J. L. Hayes
Engineering Department, Anaconda Copper Mining Co.

CERTAIN WORDS in the English language naturally associate themselves with humor. Among these is "map." In many respects it resembles "hat." Comes now the stately silk sky-piece, the grim straight-set derby, the every-day business felt, the broad-spreading sombrero, and the simple little cap; followed by their respective prototypes: the exhibition-map, the court-map, the standard engineering map, the roll-map, and the simple little sketch. Most of the world's engineering problems have been outlined from sketches; but on occasion even as stolid a science as engineering will array itself in artistic raiment.

An official map of twenty-five years ago was two yards wide and thirteen paces long. The time consumed in plotting actual engineering features was hardly half of that spent on decorative borders and pretentious titles. Such large maps were necessarily of the "roll" variety. It is not difficult to summarize their only advantage: a large area of ground shown on a single map. The disadvantages are many: (1) They require unusually large drafting tables; (2) the constant inconvenience of rolling and unrolling; (3) to be retained in a flat position they must be weighted down on the corners; (4) drafting instruments and ink bottles are placed on the face of a map, and even though it escapes the upset of an ink bottle a heavy coating of dirt and grease will accumulate; (5) letters and numbers are printed at all angles, and, the map being too large to pivot, the draftsman must sprawl bodily upon it after the fashion of a contortionist. The roll map was discarded by the Anaconda engineering department about twenty years ago.

The standard engineering map of today is of nearly the same dimensions as United States topographical sheets—18x24 in. The points in its favor are: (1) The general convenience of handling; (2) the great saving of space upon the drafting table; (3) they require no weights to be retained in a flat position; (4) all parts of the map are easily accessible for drafting and printing which must be placed at awkward angles; (5) a considerable saving of paper is effected; (6) the size of the map is really consistent with its use.

The consideration of the sixth point is important: The two principal uses of the engineering map are: (1) As a standard from which copies may be taken; (2) as a graphical representation of mining conditions to aid in the solution of innumerable engineering problems. Although the work of compiling an original may be considered as negligible, the monthly posting to which it must be subjected during a period of fifteen or twenty years—the average lifetime of a mounted map—is a large and noteworthy item. Whether posting or outlining a prospective problem on a scale of 50 ft. to the inch, it is a safe estimate that 90 per cent of such work will be confined to a space of one inch to six inches. Routine use is therefore nothing more than the sum of a large number of local references.

As a further demonstration of the relation of size to use: There are about forty engineers in the employ of the mining engineering department of the Anaconda Copper Mining Co. No haphazard map system would

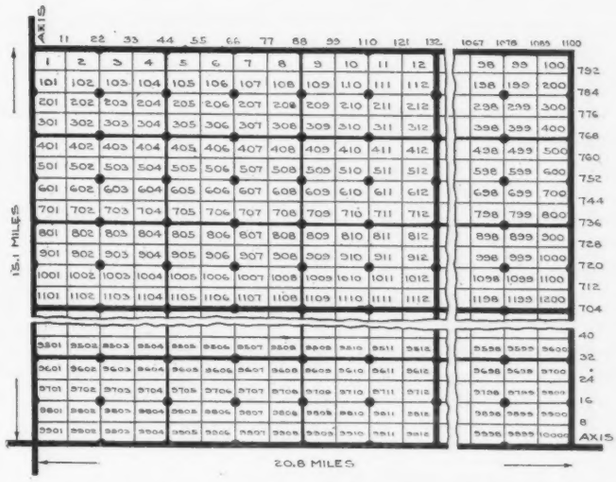


Fig. 1—The co-ordinate quadrangle and map index of the Butte district.

The complete quadrangle consists of blocks built up in checkerboard fashion from the general arrangement of map units as shown. Index numbers appear within their respective map units. Co-ordinates are given in hundreds of feet and are always printed on the north and east boundaries. Regardless of scale, maps are 18x24 in. over all. Units are 50-ft. scale; the four units within any four adjoining circles are 100-ft. scale; the heavy rectangles inclosing sixteen units are 200-ft. scale; and the heaviest block in the upper left-hand corner represents a standard 600-ft. scale of 144 units. The meridian is determined at the quadrant's approximate center. In a latitude of 46 deg., the convergency of the meridian on the eastern or western boundaries would amount to 13 minutes. As a merely practical feature, however, it has never been considered necessary to complicate the problems of triangulation with spherical trigonometry, for the many advantages of a standard meridian more than balance this small error.

be adequate to avoid unnecessary repetition of work. The task of properly orienting about two thousand miles of underground workings by means of triangulation and traverse has long ago been accomplished. Extension of working faces and connections to older mine openings and those of surrounding mines constitute the every-day problems of the engineering department. Though the larger mines require the entire services of two or more engineers, it is frequently necessary to assign several small mines which are widely separated to one crew of men. Thus, for engineer and draftsman alike, the problem is one of representing the proposed and actual details of mining in greatly scattered sec-

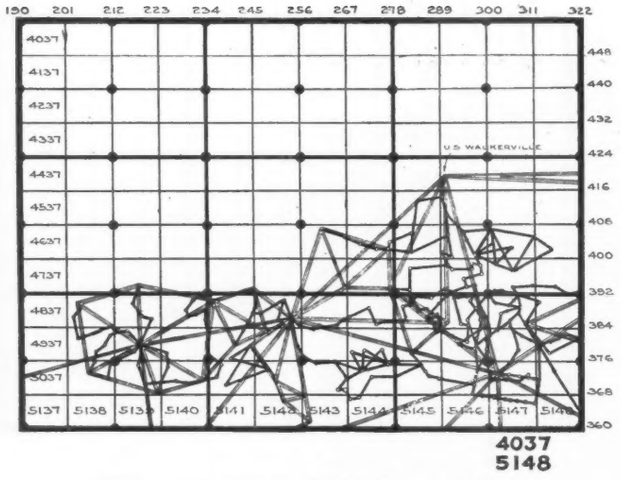


Fig. 2—A standard 600-ft. scale block.

Its allocation within the complete triangulation system may be had by referring to the "Anaconda Co.'s Triangulation of the Butte District," which appeared in the *Engineering and Mining Journal-Press* in the issue of June 23, 1923. Tri-width lines are sides of primary and secondary triangles. Heavy black lines with small circles are traverses between triangulation points. Index numbers are only shown along west and south boundaries. From these the index number of any unit or block can be determined by following the general plan as outlined in Fig. 1. Figs. 4 and 5 are all within the 200-ft. scale block in the extreme southeast corner.

tions by a quick and systematic method. After thirty years of different try-outs, there seems to be no better solution than a connected-sheet system of 18x24-in. maps on a base scale of 50 ft. to the inch.

Fig. 1 shows an outline of the co-ordinate quadrangle of the A. C. M. Co. It is 20.8 miles in an east-and-west direction and 15.1 miles north-and-south. In the early days there were at least a dozen different co-ordinate systems used by various mining companies of the Butte district. These overlapped each other in a most confusing manner. For the most part they were designed to accommodate the workings of a single mine, and so placed as to represent these in the "first" or northeast quadrant, as defined by analytical geometry.

It has been found a great advantage to confine a co-ordinated system to one quadrant. The reason for this is apparent: The calculation of survey points follows a set rule that "northings" and "eastings" of any course have a plus value, and the "southings" and "westings" are minus. Even with a one-mine co-ordinate system, unexpected development often placed the co-ordinated points in all four quadrants. Although many engineers of experience prefer a four-quadrant system, because co-ordinates may be expressed in smaller numbers, it is not practical for use in the engineering department of a large mining company where the average, and not the exceptional, engineer is to be dealt with. And to the average engineer the change of algebraic values of the latitudes and departures between the four quadrants is certain to be confusing and a constant source of mistakes. The recalculations of old surveys made by the four-quadrant method have disclosed a surprising number of errors which are directly attributable to reversion of plus and minus values.

The co-ordinate system includes the entire city of Butte and its suburbs and a large area of ground which is unquestionably of no mineral value. However, to establish the position of mining claims, section lines, and miscellaneous surface rights, such as blocks, streets, and lots, a large portion of this has been surveyed and plotted on topographical sheets. Although mining is restricted to ore-bearing formations, a review of the history of its development shows an astonishing degree of expansion. And again, the high market values of silver, zinc, and manganese during war times resulted in the opening up of a large number of old silver mines and new prospects within a radius of five to ten miles of Butte. A number of these silver-zinc properties were purchased by the Anaconda company, but as yet the diameter of the mining area does not exceed five and a half miles. But in case any of the more isolated mines became the property of the company, their co-ordinate position could easily be determined by an extension of the triangulation system. And with the

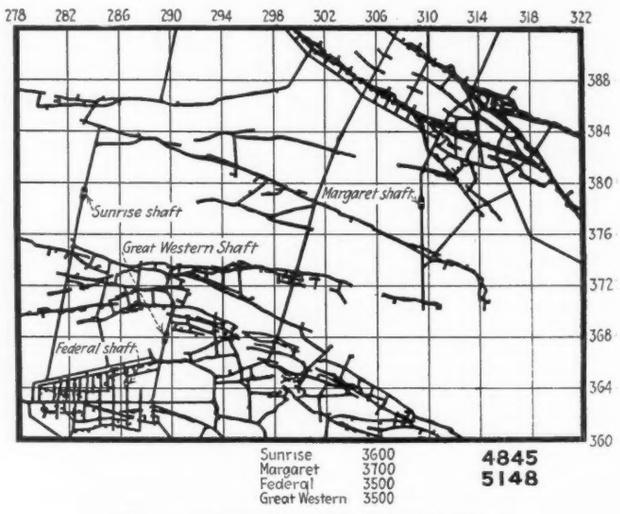


Fig. 3—An ideal 200-ft. scale block.

The shafts and vein formations are imaginary, but they are characteristic of general underground conditions of the Butte district.

present limits of the northeast quadrant such ample provision is made for future mining development that it is improbable that co-ordinated points will ever fall in any of the other three quadrants.

Once a standard map is decided upon, the next problem is to keep it a standard size. This is no easy task. The regular needs of mapping call for reproductions on scales of 50, 100, 200, and 600 ft. to the inch. Special uses easily justify the repetition of work. But it is evident that to maintain a uniform system of map indexing the similar areas of all scales must bear a fixed relation to one another; and also that a standard-sized filing case for maps of all scales is much to be preferred over one that varies according to the scale.

The smallest rectangular unit of the co-ordinate system shown in Fig. 1 represents a 50-ft. scale map of 1,100 ft. east-and-west and 800 ft. north-and-south. On the 18x24-in. standard sheets, this allows a border of 1 in. beyond the exterior co-ordinate lines. Each east-and-west and north-and-south row contains a hundred 50-ft. scale units. They are numbered like the reading order of a printed page: beginning with No. 1 in the extreme northwest corner and proceeding easterly the full length of the top row to No. 100 in the extreme northeast corner of the quadrant. No. 101 is directly beneath No. 1; No. 102 is beneath No. 2, etc. From this arrangement the following rule is derived: Index numbers of 50-ft. scale maps increase by one unit in an easterly direction and decrease by one unit in a westerly direction; increase by one hundred in a southerly direction and decrease by one hundred in a northerly direction. The entire quadrangle would therefore con-

tain 10,000 unit-maps of 50-ft. scale, with the center placed near the present locus of mining activities. Index numbers in present use vary from 4,000 to 6,000. Numbers 1 and 2; 3 and 4; 9,605 and 9,606, or any other two unit numbers of the same hundreds and thousands value (in the same east-and-west row), represent a standard stope book which when opened places the odd-numbered unit on the left-hand page and the even-numbered unit on the right-hand page. In the stope books each page bears the same unit number as that of the surface block directly above it. Vertical designations are made with reference to mine levels as: Leonard Mine, 2,800 Level, 14th Floor. A series of stope books for a mine of 3,000 ft. depth would contain about 375 unit maps of 50-ft. scale.

Numbers 1, 2, 101, and 102; 9,605, 9,606, 9,705, and 9,706—or any other four units within four adjoining co-ordinate circles—are 100-ft. scale maps of standard dimensions and bear the index numbers of their northwest and southeast units: 1-102; or, in larger numbers, 9,605-9,706. This diagonal form of index numbering is used with all maps containing more than one unit. The rectangles bounded by heavy lines and inclosing sixteen units define a standard 200-ft. scale map. They are indexed as 1-304, or 9,605-9,908. The rectangle in the upper left-hand corner of Fig. 1 within the heaviest boundary lines incloses 144 units and

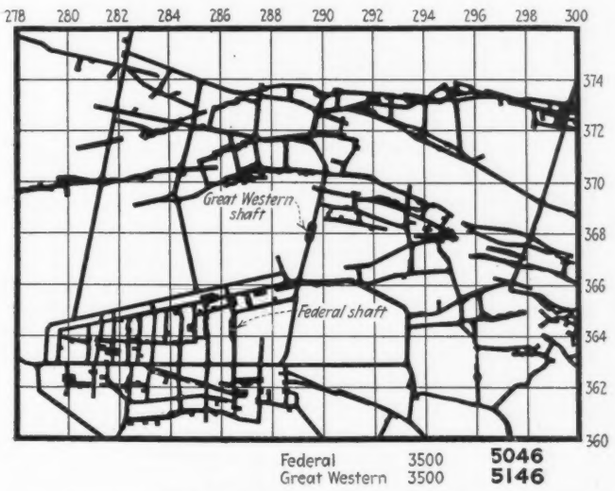


Fig. 4—An ideal 100-ft. scale block. This represents the SW¼ of Fig. 3.

represents a standard 600-ft. scale block. It is indexed as 1-1,112. This is the smallest scale map which forms a part of the regular index system.

All of these maps being of uniform size, they are filed in standard cabinets according to scale. Map cabinets are 2 ft. x 2 ft. 5 in. x 4 ft. 5 in. and hold fifteen drawers, each of about 2 in. deep. Cases for stope books are of nearly the same dimensions.

A 600-ft. scale map as shown in Fig. 2 is used for a subindex. Primary and secondary triangulation points and surface traverses are plotted on these sheets, which also indicate the 50-ft. scale-index numbers. They are a great convenience for assembling the notes of a large survey and making an estimate of the position and number of unit maps needed. On these are given numbers and location of all survey points included in closed traverses. Since the many miles of underground workings are derived from the triangulation and traverses adjusted thereto, the mapping of this base work is highly important.

The 200-ft. scale map finds its chief use in special problems: Drainage systems, mine ventilation, geological data, handbooks for superintendents and foremen—it serves the requirements of a large area of ground shown in a small convenient space. To a greater degree the 100-ft. scale map serves the same end, but gives, where needed, additional detail.

The 50-ft. scale, being the original from which all other maps are copied or pantographed, receives the bulk of engineering attention. Each map represents a single level. There are no composite maps. This insures a clear, correct reproduction of the surveyor's notes. It is impracticable to give more than a general outline of mine workings on the 100-ft. and 200-ft. scales, and the intermediate "floors" are omitted entirely; but in the 50-ft. scale stope books all levels and stope floors are shown. These contain from 75 to 100 pages each and give, in great detail, a vast amount of mining data, such as numbers of sills, raises, stopes, chutes, or other data; the position of timber wherever used; location of survey stations; date of excavation and other miscellaneous items. In substance the pages of the stope books represent horizontal sections cutting through the earth at 8-ft. intervals.

If the total area included in the stope books of the Anaconda company—exclusive of repetitions—were to be reduced to a single mammoth map of a scale of 50-ft. to the inch, its actual dimensions would measure 317-ft. x 317-ft. and embrace a scaled territory of 1,058 square miles. This is the total of 33,520 unit maps of 50-ft. scale which the stope books contain.

Aside from the study of map systems for general interest, their relation to the cost of office maintenance is a consideration which merits no little thought. During the last eighteen years the number of engineers employed in the main office of the Anaconda company has increased about 240 per cent. To balance this, the office space was increased only by about 33 per cent. With a standard map of the "roll" variety, or even moderately large flat maps, there would have been no alternative save that of a proportionate increase of floor space. Where office rooms are rented this saving is easily a worth-while consideration.

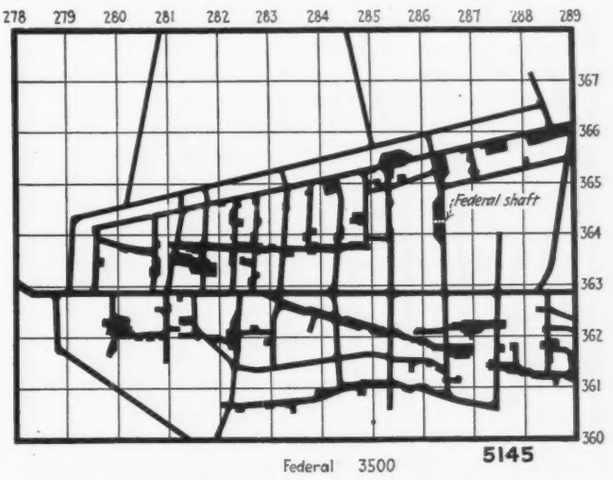


Fig. 5—An ideal 50-ft. scale unit.

On an enlarged scale it shows the S.W. ¼ of Fig. 4 and the S.W. ¼ of the S.W. ¼ of Fig. 3. Owing to the small size of reproduction here, it is impossible to show the many features which are embodied in the standard units of this scale. There are thirty-three 520 units in the stope books of the Anaconda company.

Gold-mining Activities in Bohemia

Reviving Interest Shown in Ancient Properties—Output Is Moderate

By Dr. Robert Goering
Charlottenburg, Germany

THE ROUDNY mines are the only large gold mines in Czechoslovakia. Mining has been carried on there systematically only since 1904, although some of it has been done as far back as the eleventh century, but it was subsequently abandoned. The mines form a hill of gneiss in the Votic district, about 5 km. distant from the known Blanik Mountain. Various quartz veins running wedge-like into the gneiss carry the gold and extend all through the formation. A German firm began work there in 1892 with good success. Later on the mines came into the hands of a Czecho-French company, from which they were purchased by the present English owners. About £250,000 is invested. The owners keep £35,000 of the profit and put the balance back in the undertaking, which pays well under a most able management. The equipment of the mines is modern and uses Transvaal practice. From a vertical shaft 420 m. deep at the principal mine, Vaclarka, the ore is hoisted at the rate of 120 tons daily. The average gold content is about 5 oz. to the ton. Before the war, in 1913, 30,000 tons was mined, yielding 326 kg. of pure gold and 167 kg. of silver. The average output of the mine in previous years was about that figure yearly also. The gold is 650 fine in the upper levels and 670 lower down where the ore is richer. From 1914 to 1920 mining results were as follows:

Year	Monthly Hoist, Tons	Gold Output In Kg.	Number of Laborers
1914	2,000	279.30	235
1915	1,600	211.11	253
1916	1,650	221.60	244
1917	400	153.26	244
1918	500	97.43	245
1919	750	150.93	282
1920	800	186.10	299

A larger tonnage up to 3,000 per month has been worked in the years 1910 to 1914, but the gold output was the highest in 1913. During the war work was irregular. In 1915 and 1916 one month's operations were lost, and in 1917 the mine shut down for five months, in 1918 for seven months, 1919 five months, and in 1920 one month, for want of transportation and shortness of coal. The gold price changed according to the exchange position of the kronen. Up to 1914 the standard price was 3,274 kronen per kg.

The yearly average of work done by one miner amounted in 1913 to 1.42 cu.m., but in 1920 it was only 0.60 cu.m. The reduction works consist of stamp mills, concentrators, and cyanide plant. Sixty per cent of the gold is won by amalgamation, and the tailing consists of sands, which are cyanided; pyrites, which are sent to Freiberg for treatment; and slimes, which accumulate for later treatment. There are 130,000 tons of the latter at Roudny containing 500 kg. of free gold. The sands yield about 26 per cent of the pure gold contents and the pyrites about 16 per cent. The raw gold bullion is 665 fine in gold and 322 fine in silver.

Another old gold-mining district is that of Bergreichenstein. In the thirteenth and fourteenth centuries the mines there made their best production. About seventy years ago they were abandoned. In 1918 the Zirnostenska Bank bought a controlling interest in shares of the existing Goldgewerkschaft and financed development work. As at Roudny the gold occurs in gneiss. Micaceous gneiss in transition to mica slate forms the country rock. Two old adits and a new one are used to develop the mine. The payable ore occurs in the quartz fissures and veins of volcanic origin. The pyrites are barren, and other minerals have not been found. The thickness of the ledges varies from 5 cm. to 1 m. or more. In 1919 the ore from an ore chute 0.2 m. to 0.8 m. thick contained 10, 12, 28, 30, and 96 gm. gold per ton (31.1 gr. = 1 oz.). A report in 1921 states the ore to assay 10, 15, 25 gm. and more per ton.

Near Libezic are ancient gold mines in places 150 m. deep in granite. Those southwest of Neu-Knin were reopened in 1911 and equipped with a modern Krupp concentration plant. The orebody, crossing the granite, in places is 1 m. thick and contains iron and arsenical pyrites. In 1920, 6,950 tons of gold ore was mined with 106 miners, and the concentration works yielded on a trial run 7 kg. gold. Another mine is owned by one "Sylva Tarouca" and contains large ore reserves averaging 12 gr. gold per ton. Production began there late in 1921, the output being 19 kg. gold. Early in 1922 80 miners worked there. The plant has been enlarged.

Of further and particular interest is the district near Upper Licznice, on the Moczidlo Mountain, and near Smolzately, southeast of Pribram. The mining investigations here showed that deep-reaching auriferous veins cross granite and the slate. S. Grimm, a former president of the Pribram mining academy, and others stated that on that mountain gold mining had been carried on in the thirteenth and fourteenth centuries, as evidenced by numerous small dumps and holes. In the early years of the nineteenth century prospecting of some of these old dumps and holes led to more extensive mining for silver by adits on the slope of the Moczidlo Mountain. These adits opening the ground at various depths run through many quartz and other veins, which, however, at that time were not investigated any further and not followed up, and their apparently low gold content was disregarded. None of these adits was extended to the known orebodies in the upper part, nor to the gold-bearing veins in the lower levels in the thirteenth and fourteenth centuries. In 1920 new tests at the old dumps proved higher gold contents of the quartz samples, and further investigation showed the presence of telluride of gold, silver, and bismuth. This led to the reopening of the adits and sampling the crossed veins, which proved good gold ore and eventually the existence of a highly mineralized zone 2,500 m. in length, where in short distance parallel and payable gold-bearing veins followed each other. The extent of this ore occurrence is proved for about 45 km. in length.

According to our present knowledge regarding the abandoned old mines in middle and southern Bohemia, these have not ceased work on account of troublesome times in the early days, but mainly on account of primitive methods and financial difficulties, and sometimes because of trouble in early days of operation. But today, with modern technical and chemical improvements and ready capital, Bohemia offers a large field and fair success for well-conducted enterprises.

An Experimental Study of Ball-mill Grinding

Large Amount of Inactive Space in Mills of Ordinary Type Suggests Variation From Cylindrical Form

By Donald H. Fairchild
Metallurgical Engineer, Chicago

EXPERIMENTS and observations that I have made indicate that the reduction of the ore within a ball mill is due mainly to impact grinding or crushing. Attrition and dead weight are important contributory factors in the reduction of the ore, but they are of much less importance than impact crushing, judging from the work actually accomplished. Fig. 1(c) indicates the condition that probably exists within a ball mill under proper operating conditions. In studying the action of the balls, a model mill with a heavy glass end was used. To supplement visual study and photographs that were made of the mill at various stages of operation I made many feet of moving-picture film showing the mill in all the stages from a gradual start to maximum speed, at which the balls and ore were held to the shell by centrifugal force, and back down to a stop. This film, when run at slowest possible speed through the projector, makes the action of the balls much more clear than would be possible by other methods. I expect to carry this out still further by making another film, this time using an ultra-rapid camera. This will permit of a better analysis of the action of particular balls.

The study of the balls in action leads me to believe that that portion of the ball charge found in the zone marked *A* Fig. 1 (c) does the most effective work, inasmuch as it is in greatest motion. In the upper portion of this zone the balls do their work mainly by attrition, but as they progress toward the lower part and gain speed their value for impact crushing and grinding is increased. In zone *A* the grinding is, for the most part, done by impact and attrition.

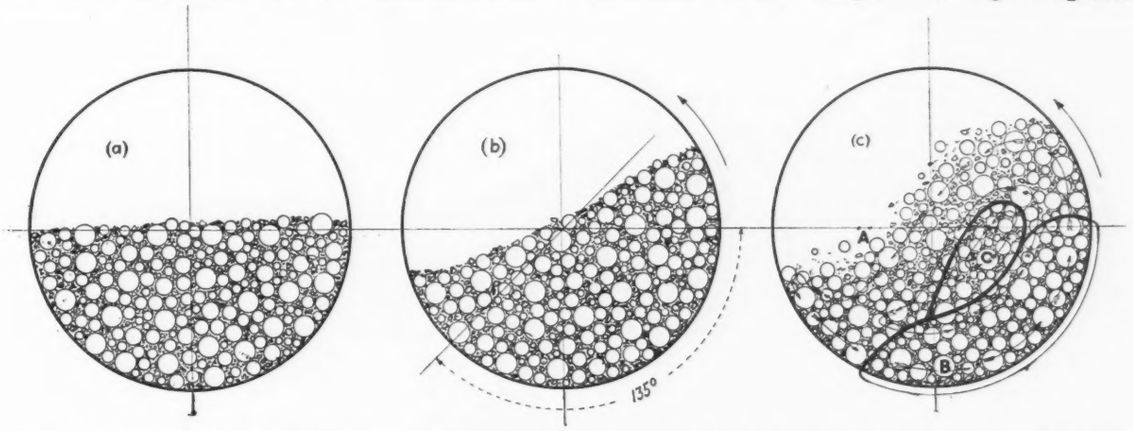


Fig. 1—Action within cylindrical mill. (a) Ball load horizontal; (b) ball load at maximum angle of repose; (c) balls in action at proper mill speed. Heavy black line indicates division between grinding zones

The balls in zone *B* in the same figure are practically at rest except for such movement as is caused by the settling of the ball mass, due to its dead weight, crushing the ore particles between the balls and allowing the whole mass to condense somewhat. Careful inspection of the balls next the shell failed to show that slippage or rolling action occurred within this mass to any degree that would be productive of much grinding. I was surprised to note this, as I had always believed that there was considerable movement within the mass itself. Through about 135 deg. of the revolution the balls are practically quiet, but their great weight is productive of a crushing action that is effective. On the other

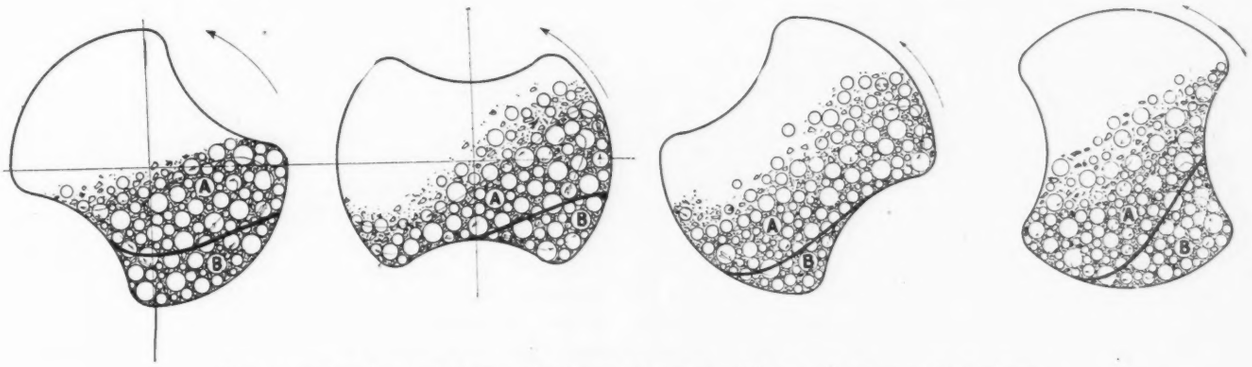


Fig. 2—Showing greater agitation obtained within mill of special designs

hand the balls in zone *C* are least productive of all, it would seem. In this zone is the minimum of dead weight and the minimum of movement, some of the balls traveling only a few inches.

In all present types of mills the degree of agitation of the ball load is practically equal in mills of equal size at the same speed. The type of shell liners used affects to some extent this agitation, but no liner seems to cause useful movement of the ball mass in zone *B*.

Fig. 2 illustrates a type of mill shell that I used experimentally to produce a rapid change of position of ball load. The action within this mill was as indicated in the sketches. In this mill there is no zone that resembles *C* of Fig. 1(c). The greater portion of the ball load is found at all times in zone *A*, Fig. 2. Only a comparatively small portion of the load is in zone *B*, where crushing is mainly by dead weight. This is the reverse of the condition within the ordinary cylindrical mill. Study of this action indicates that it would be productive of much more work than the cylindrical types, but it would likely create an excessive liner and ball consumption out of proportion to the increase in grinding ability. The greatest drawback and the one that seems to relegate it to the "attic" as another of those interesting things of no economic value is that it would produce an enormous "back-lash" that would prove ruinous to any driving mechanism with which I am familiar. The change of location of the center of gravity is so sudden and so great that at one moment practically no demand would be made on the power source, but at the next the maximum peak would be reached, only to drop immediately to near zero again. If there were a method of balancing such an action the possible good features might be preserved and the bad ones eliminated.

Probably the six most important factors governing the capacity of a ball mill, outside of the characteristics of the ore, are:

1. The diameter of the mill.
2. The weight of the ball load.
3. The speed of the mill.
4. The rapidity with which the mill content is changed.
5. The size of balls used.
6. The degree of agitation within the mill and the character of such agitation.

No attempt has been made to list these factors according to their relative importance, inasmuch as there is ample reasoning to support many different arrangements and no good purpose could be served here by attempting to do so.

Future development of the ball mill will be toward securing a more rapid change of mill content and producing a more effective agitation within the ball mass.

Mining Mica in India

Systematic Prospecting and Improved Methods Should Develop the Industry

By E. W. T. Slater

THE MINING OF MICA is an important industry in India, and there is reason to believe that large areas hitherto worked only superficially will be opened soon. The industry has had its fluctuations, but provided it is well organized and care is taken in the marketing of the product, Indian mica ought to hold a high place in the mining world. The invention of micanite, in the production of which small and inexpensive sheets of mica are cemented together by shellac under high pressure, led to a diminution in the output of Indian mines, as they were not able to compete with the new substance; but other uses of mica have been found, and for such purposes as wireless telephony and telegraphy there will be an increasing demand for this material. In India sheet mica is produced in large quantities.

There are two great centers of mining activity, one in Bihar and Orissa, and the other in the Nellore district in the Madras Presidency. The belt in the latter district occupies the eastern half of the Madras coastal belt, over a tract of country about 60 miles long and 10 miles broad. Though this is the most important area for mica mining in the Madras Presidency, deposits have been found in many other districts. In the Bihar region there is a belt about 60 miles long and 112 miles broad. Not far from the main area, there are smaller districts, and several deposits have proved to be profitable. In Ajmere several areas are also being worked.

In the Bihar belt the mica is found associated with gneissose granites. The belt is irregularly scarped and falls by a series of ghats from the Hazirbagh plateau to the Gangetic plain. Owing to the denudation of these areas the work of prospecting was easy. The schists are of great variety and are metamorphosed rocks of diverse origin, some sedimentary and some igneous. The foliation planes of the schists and gneisses are generally in conformity, and the whole structure suggests that the two have been folded up together, the present appearance being due to denudation. The gneissose granite is composed of quartz and microline, with biotite and hornblende and accessory sphene, zircon and apatite. In the Nellore deposits the whole is composed of one series of schistose rocks. The rocks are in general hornblende and biotite schists, with subsidiary quartz ridges. The series in the mass is uniform, but in its ultimate geology there is a great variety. The country is flat and the pegmatites occur parallel to the foliation of the inclosing rocks. The large masses are coarser in structure than the smaller masses.

The mining methods adopted are simple and primitive. Most of the mining in the Bihar district is carried on by sinking a narrow winding hole from "book" to "book" of mica, and the mica, waste, water and all, is raised to the surface by hand. In some mines, however, the work is done by skilled workers. Mine plans and sections are kept up to date, and an attempt is made to exploit the area on systematic lines. Compressed-air drills are now introduced into the work, and this has led to an increased output. In the Nellore district the work is done by open-casting all deposits. The excavations are not carried deep, as a rule, few being more than 150 ft. Holland says: "The method is wasteful in that the whole of the pegmatite, including the barren portions, is handled. The dump is put on the lip of the hole, and has to be rehandled for extension; moreover, it affords easy access to all surface water, and after rain the pit requires cleaning before the work can be resumed. The continuance of this method is largely due to the complete lack of mining knowledge among the supervising staffs."

This criticism shows the great need for the introduction of more systematic and improved methods of working this valuable material.

Some Typical Free-Milling Gold Deposits of Japan

Idle Mines That Produced Years Ago May Be Reworked with Modern Methods—Occurrences Are in Quartz-Calcite Veins in Tertiary Andesite

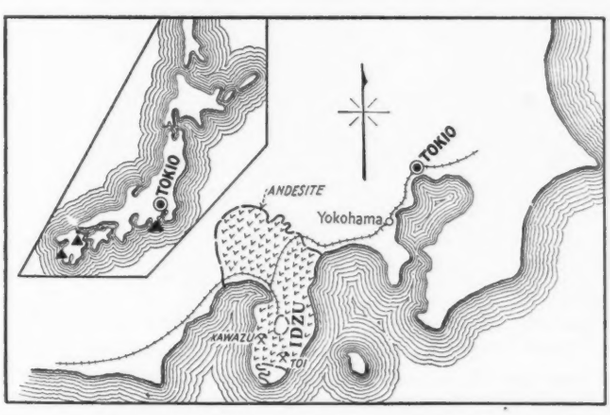
By H. Nishihara
Mining Engineer, Tokio, Japan

JAPAN has three representative free gold mining districts. One is on the Idzu Peninsula, the second in the southeastern part of Kyushu Island, and the third in the southernmost part of that island. Geologically they are all directly related to the Tertiary or post-Tertiary andesite or liparite intrusives. In the Idzu Peninsula the deposits are fissure veins occurring in either andesite or liparite. There are at least five gold mines of some importance—namely, Kawazu, Rendaiji, Suski, and Nawachi, in the south, and Toi, on the western shore of the peninsula.

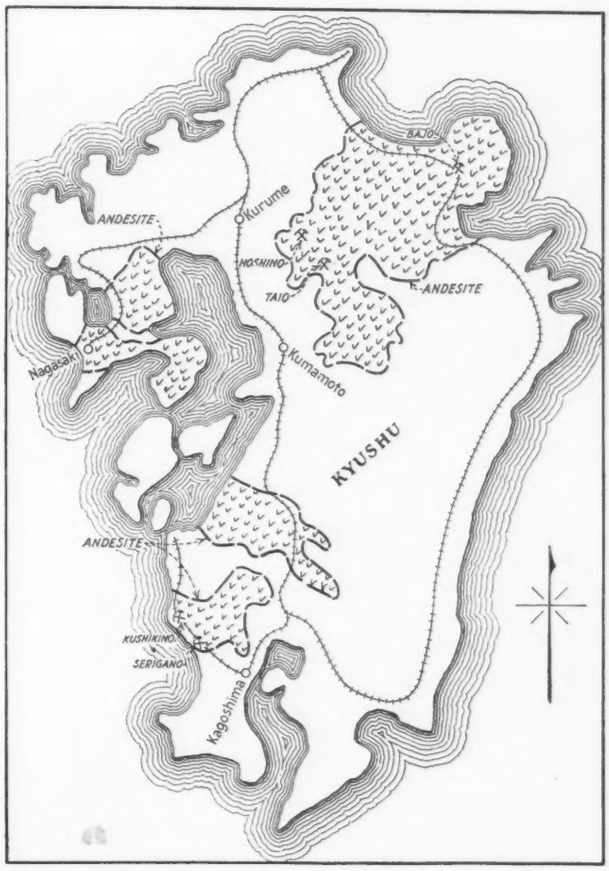
In general jointings are highly developed in either andesite or liparite. Many strike faults or slips displace the vein, and owing to the brittleness of the highly siliceous vein matter, fault breccia is prevalent. Owing perhaps to this, oxidation extends at some places to 500 ft. below the surface. The vein is uniform from the surface down to that depth, and walls are, in general, fairly well defined. The width of the vein is 3 ft. on an average. The tenor of the ore is approximately $6 per ton in gold, and ratio of gold to silver averages about one to ten. The relative content of gold and silver is rather variable, but generally at or near the surface of the ground or in the oxidized zone the proportion of gold to silver is greater.

Gold Content Decreases With Depth

The gold decreases and silver increases with depth below the oxidized zone, and the pyrite increases in proportion with silver. Manganese dioxide is practically absent, and dissolution and redeposition of gold seems to have been inconsequential, although in the kaolinized or highly brecciated and limonite-stained part of the vein in the oxidized zone, the gold content is higher than elsewhere. At such places the gold content is twice as high as in the primary unenriched vein. Gold and silver enrichment plays so unimportant a part in the deposits that the valuation of mines here is practically based on the primary content of gold and silver in the ore.



Part of Japan, showing the Idzu gold-mining district



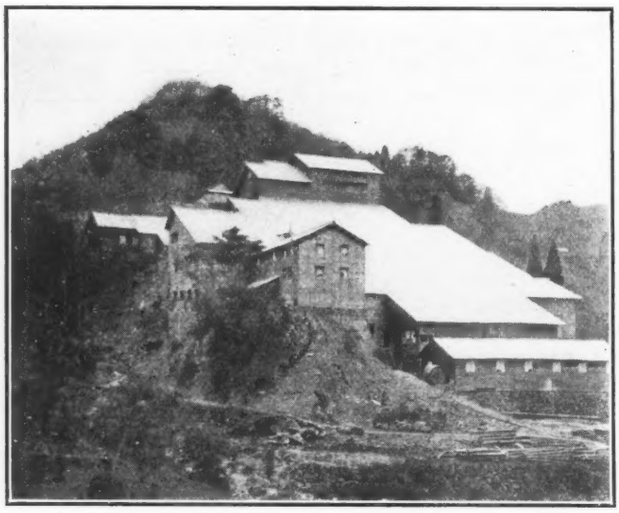
Kyushu Island, showing the location of various gold mining districts

There is no amalgamating or cyaniding plant in the peninsula, and the picked ores or concentrate are all shipped to copper smelters as fluxes. Generally speaking the veins are all strong to a depth of more than 1,000 ft. from the apex, but, as stated, the gold content decreases with depth. Other disadvantages are the extreme hardness of the vein and the great inflow of underground water, the pumping of which is sometimes responsible for the greater part of the expenses of mine operation.

The gold ores in Kyushu Island are, with a few exceptions, all of free-milling type. As in Idzu Peninsula, the deposits are closely related to the Tertiary or post-Tertiary andesite intrusives, which are prominently developed.

The northeastern district is represented by the Hoshino group, in which the Taio is the most prominent.

This district is in general at a high altitude—about 2,500 ft. above sea level. The annual precipitation is heavy and erosion is intense. Mountain sides are steep; valleys are deeply cut; the streams have swift currents and sharp turns. The hills are all covered with natural shrubbery as well as planted cedars. The locality is perhaps one of the most beautiful mining districts in the empire.



The Taio cyanide plant is equipped with all-sliming machinery

The deposits are closely related to the Tertiary or post-Tertiary porphyritic andesite, which intrudes into Paleozoic chlorite schist. The schist strikes in general from northeast to southwest and dips either to the north or south at an angle of 30 deg. At the contact with the andesite the schist is broken and overturned in blocks, some of which are 200 ft. square on the surface. Also, at the contact small fragments of the schist are included in the andesite, and practically no fusing or baking of the schist in contact with the andesite can be detected with the naked eye.

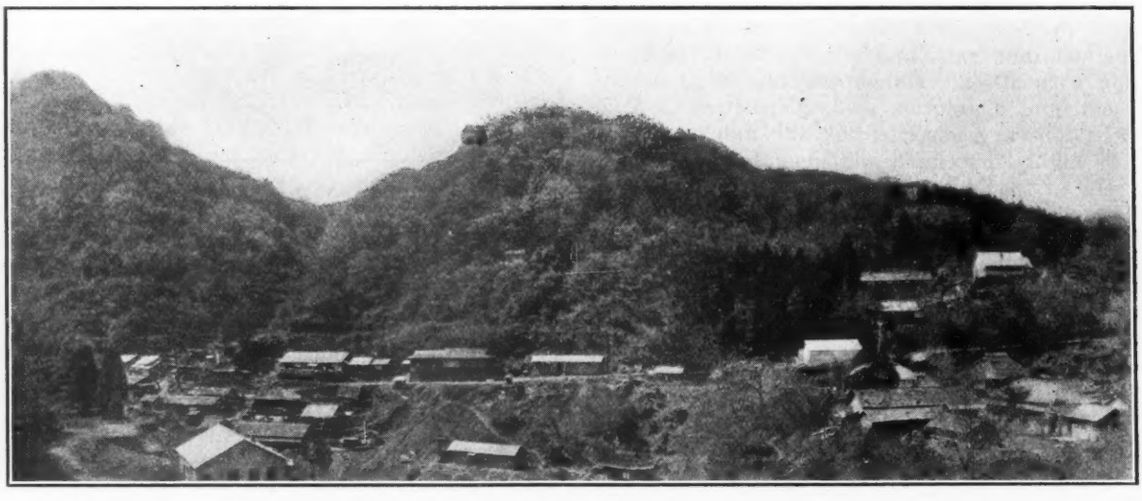
The deposits are steeply dipping quartz veins that cut through the andesite. The walls of the vein are fairly well defined and small strike faults or slips along the vein are common. The character of the veins varies, but it is to be noted that the payable ore is found in the vein consisting of quartz and calcite. Sugary white quartz and quartz stringers cut through calcite, and quartz pseudomorphs after calcite are common in the vein. Such veins are full of vugs stained with manganese dioxide and limonite. Fine pyrite is abundant in some veins, especially where pyrophyllitization of the andesite has occurred to some degree.

Some years ago several mines were started, but none of them lasted longer than three years. The tenor of ore is on an average $5 per ton and ratio of gold and silver is about one to seven. The width of vein varies from a few inches up to 20 ft., and the old workings show where a vein less than 5 in. wide has been followed. Extreme hardness, narrowness of vein, and low value in gold seem to be the reasons for discontinuing further development, although veins are numerous and some gold and silver is present.

The Taio gold mine, which is situated southeast of the Hoshino mines, is also a vein deposit in the Tertiary andesite. There are five important veins, of which only two parallel veins are extensively worked. The system of veins trends in general from east to west and is offset at many places by small strike faults, deflecting to the northwest and west. The width of the veins ranges from 1 to 40 ft., due to strike faults along the vein. The movement is well shown along the walls.

The vein consists mainly of quartz and calcite. Silver may occur in the form of silver sulphide, with fine-grained pyrite. Some crystals of pyrargyrite have been detected under the microscope. The vein matter occurs generally in bands including angular fragments of fault breccia. The pay streak is a narrow band of opaline quartz of dark grayish color. Quartz and calcite are intermingled and quartz replaces calcite at many places. In the oxidized zone of the upper levels vugs are numerous and are stained with manganese oxide and limonite. Where underground water circulation is intense, these clayey materials are all washed away, leaving spongy quartz skeletons in the vein. The secondarily enriched zone, which was all mined out many years ago, was, as the mine records show, within 200 ft. of the surface, and on an average was less than 100 ft. thick.

The tenor of ore at present is $7.25 in gold and $1 in silver per ton. The cyanide plant, of the all-sliming



The workers of the Taio gold mine live here. The settlement might be called a "camp"

type, treats daily 250 tons and makes an extraction of 87 per cent of the gold and 35 per cent of the silver. This mine was unknown five years ago. The present company for the last four years has paid annually dividends of more than 20 per cent, and, next to the Kushikino gold mine, is now the most productive in Japan. The success of this mine was due wholly to the deep mining, and in this connection it is interesting to note that there are still many mines in Japan that have working records of several hundred years, yet have not been worked farther than the ground-water level. Like most of the Korean mines, the old-timers, as many traditional records relate, could not overcome the water at depth. Many of these mines have been reopened, the use of new machinery making possible work that the ancients failed to accomplish.

Fissure Veins in Andesite

Typical gold mines in the southwestern part of Kyushu are the Kushikino and Serigano, two old mines with long records. The orebodies of both mines are fissure veins in the Tertiary andesite and are quite similar to that of the Taio mine, just described, as far as the characteristics of the vein are concerned.

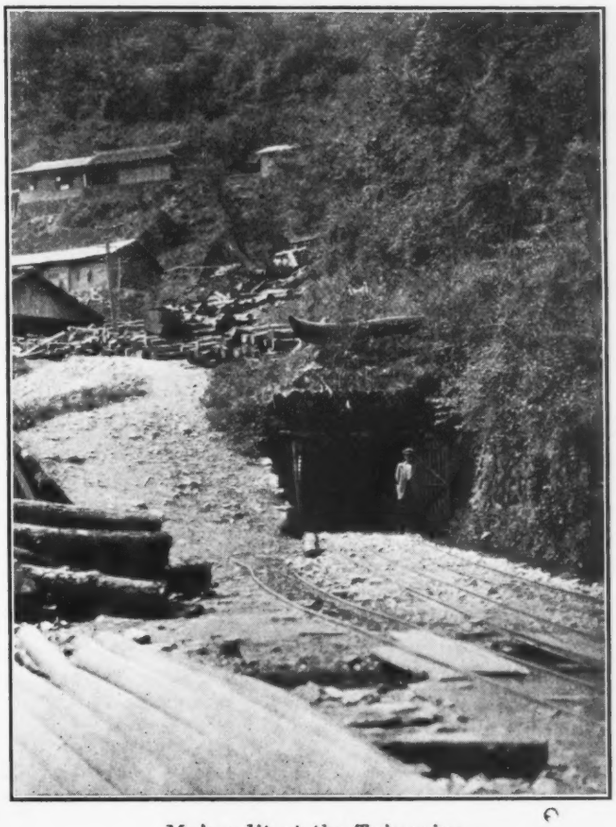
Kushikino is owned by the Mitsui Mining Co. and is at present the most productive gold mine in Japan. The deposit is also a fissure vein in the Tertiary andesite; it strikes almost east and west and dips south at an angle of 50 deg. The vein is made up of calcite and quartz and runs for a distance of over 6,000 ft. It averages 10 ft. in width, and the walls are sharply defined. No other gold veins in the empire have approached this vein in respect to length, width, and strength and production. Quartz and calcite are intimately mixed or lined up in alternate bands. The hanging wall is much brecciated and stained strongly with manganese oxide and limonite. The pay streak is in the blue-banded opaline quartz about 3 in. wide near the hanging-wall side. At some places in the vein the calcite becomes so abundant as to occupy nearly the whole width. The calcite is in large crystals, whereas the quartz is sugary, except where it is a pseudomorph after calcite. Here again the fissure was first filled with calcite followed by silica that carried gold and silver. Owing to the abundance of calcite, although manganese dioxide is prevalent, secondary enrichment of gold seems to have taken place at rather a shallow depth. The enriched zone was struck between the third and fourth levels, or 300 ft. below the surface, and continued to the sixth level.

Annual Production of One Mine $550,000

The workings extend to the sixth level, or 600 ft. below the entrance to the crosscut, the elevation of which is 320 ft. above sea level. There is another incline that reaches the eighth level. At present the mining is principally on the fifth and sixth levels for a distance of about 800 ft. Only high-grade ore is being extracted. The tenor of ore runs as high as $18 per ton in gold and $5 in silver. At present the mill is daily crushing 250 tons and the ore is being treated with cyanide. The annual production has long been uniform, about $550,000. For 1923 the record up to May is: January, $46,972; February, $44,780; March, $38,237; April, $45,972; May, $50,372.

The Serigano gold mine is situated south of the Kushikino. The country rock is Tertiary andesite similar to that at Kushikino. The andesite is cut by several quartz veins, and the most important vein strikes east-west and has been traced for a distance of 3,000 ft. There are three more veins that branch off the "mother lode." Small strike faults are numerous, especially in the eastern part of the concession. The veins bend or divert from the main vein, but the general trend is east and west; the dips vary from 45 to 60 deg. toward the south. The width of the vein varies from 2 to 6 ft. The width is especially variable in the eastern part of the vein, where faulting is general.

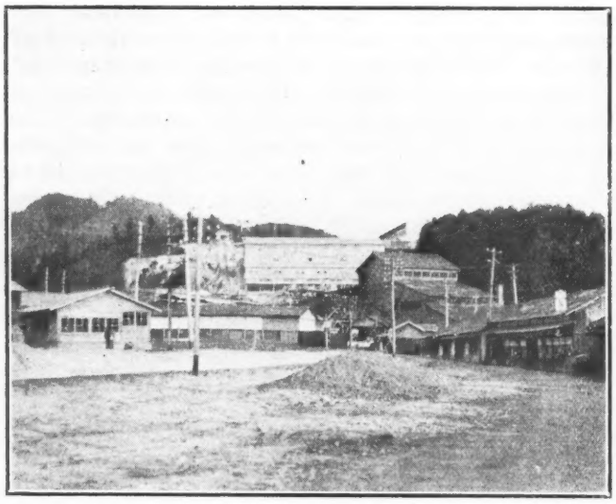
The ore deposit is a regular fissure vein consisting of light-blue dense quartz and crystalline calcite stained dark brown with oxide of manganese and limonite and



Main adit at the Taio mine

disseminated pyrite. The vein resembles that of Kushikino, especially in regard to the abundance of calcite. In the oxidized zone the greater part of the vein is made up with a skeleton of quartz filled with wad and limonite. Owing to the highly fractured nature of the country rock, the circulation of the underground water must be vigorous. Rapid oxidation of the sulphide is strikingly shown by the extensive coloration of the country rock within as well as without the mine. The width of the vein is on an average 4 ft., and the pay streak is in the banded quartz about in the middle of the vein. Both walls are lined with fine-grained calcite crystals; the vein filling is calcite and quartz, the middle portion being metal-bearing opaline quartz. Pyrite and manganese dioxide are found either in dissemination or in veinlets in the quartz or calcite. It is noted that the silver content is high wherever pyrite is abundant. The vein walls are all well defined, but in many places lenticular country rock is included in the hanging-wall side of the vein.

Owing to the primary composition of the vein, the



The Bajo mine buildings

secondarily enriched zone was shallow, and most of it has been extracted above the ground level, which is 130 ft. above sea level.

The ore averages about $10.80 per ton in gold; and the ratio of gold to silver is seven to one. The production has been decreasing for some years, and at present the mine is being little developed. Some failure in the administration may be the fundamental cause of the recent inactivity.

To summarize: The free-milling gold ore deposits in Japan are all geologically related to the Tertiary or post-Tertiary andesite or liparite intrusives.

The deposits are all fissure veins that cut through the andesite or liparite.

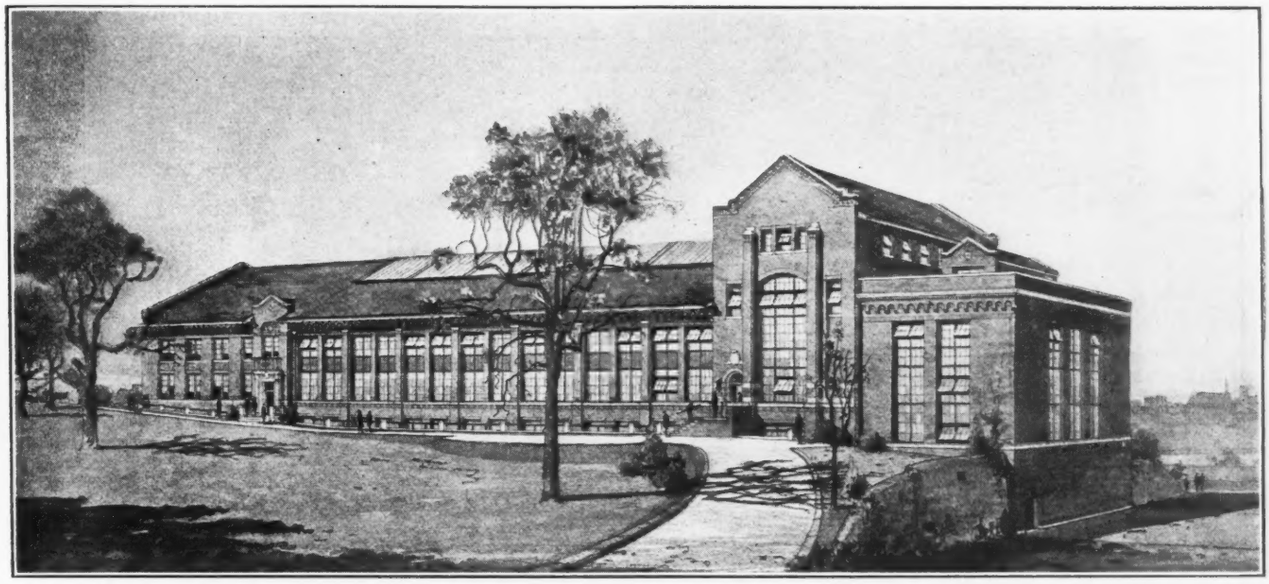
The veins in Idzu Peninsula are mainly quartz, with pyrite dissemination. Manganese oxide is rare. The tenor of ore is on an average $6 per ton. The content of gold decreases and of silver increases with depth. Secondary enrichment of gold is not conspicuous.

The gold veins in Kyushu Island consist of calcite and quartz and are in general highly charged with pyrite and manganese oxide. Secondary enrichment of gold is conspicuous and without exception the enriched zone is found at shallow depth. The primary ore averages $8 per ton and the ratio of gold to silver is ten to one.

The treatment of the ore is by amalgamation or cyanidation, or the two are combined. At the Bajo mine, owing to the high content of stibnite, a specially designed flotation method follows amalgamation.

Anaconda Copper Mining Co.'s Great Falls team, which won the first prize in this year's International First Aid Contest at Salt Lake City

Left to right, Edward Egan, George L. Roberts, Leon J. Deranleau (Captain), Vizzo S. Paulson Gordon D. Gillis, and Joseph Macure



Architect's drawing of the newly completed ore-testing plant at Minneapolis

Minnesota Finishes Model Ore-testing Plant

Building and Equipment for Mines Experiment Station Cost $300,000— *Flexibility Permitted by Unusual Design*

By Arthur B. Parsons
Assistant Editor

A CASUAL GLANCE at the illustration on the next page showing the main operating theater of the new ore-testing plant of the Minnesota Mines Experiment Station probably would warrant the conclusion that the building was finished, but that no start had yet been made toward installing the machinery and equipment. That conclusion, however, would be in error; the plant is now ready for operation. The machines are not to be installed in the sense that they will become permanent fixtures in the building. Instead, each piece of equipment—roaster, ball mill, classifier, jig, concentrating table, cobber, magnetic concentrator, filter, sintering machine, or whatever else may be needed—is mounted on a portable timber or steel foundation of its own.

Each unit is self-contained, having its own motor mounted on the same frame. When not in use the machines will be stored on the mezzanine floor—in fact a number can be seen there in the photograph. Most of them are not standard-sized machines; they are, however, built like their big brothers and serve exactly the same purpose. Commercial conditions are duplicated to an unusual extent.

Stations Supply Power, Water, Gas, and Air

The ten-ton crane that spans the main testing room is automatic, and is operated by ropes from the floor; it is used to transfer the equipment from place to place. At each of ten steel pillars that support the balcony is a station for the distribution of the following: high-pressure air, low-pressure air, vacuum (if that can be distributed), steam, illuminating gas, water, and electricity—high-voltage alternating, low-voltage alternating, and direct current.

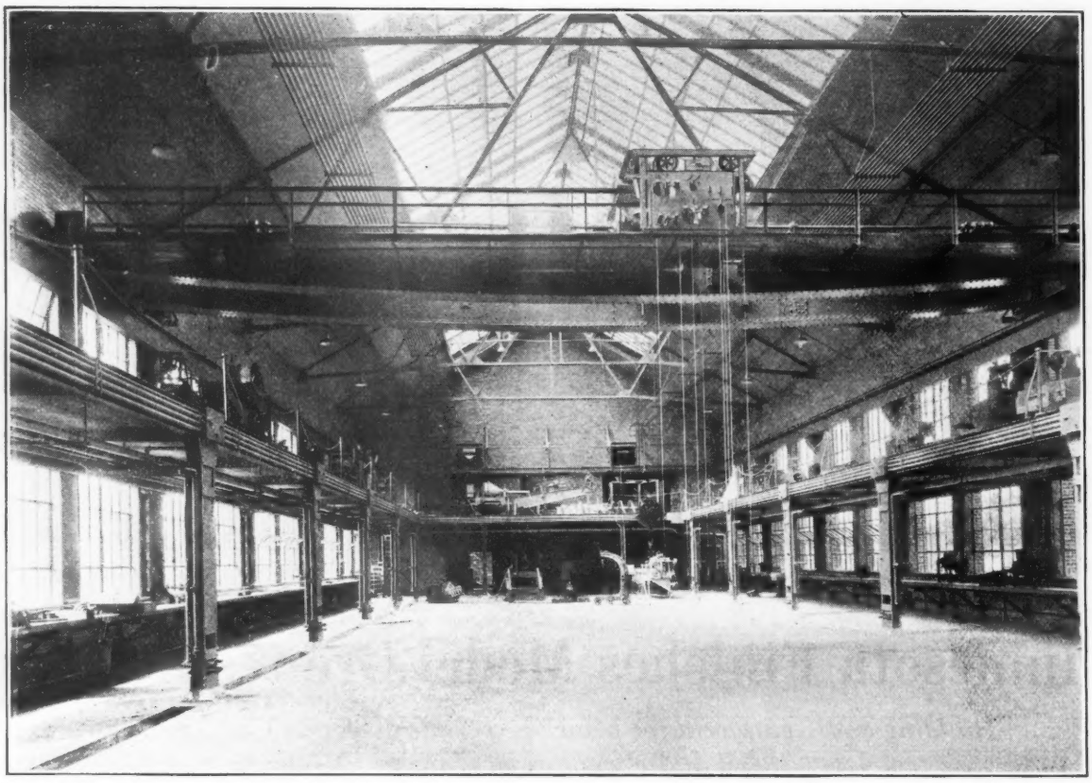
When the metallurgist has prepared a flow sheet on paper he hands it to the millwright, who quickly arranges the equipment and necessary connecting launders near one of the various stations for supplying water and power. If it is desired the first machine can be placed on the balcony; likewise, holes in the main floor make it possible to place part of the equipment on the level below. As many as ten tests can be carried on simultaneously if sufficient individual machines are available.

Flexibility of Operation Important Feature

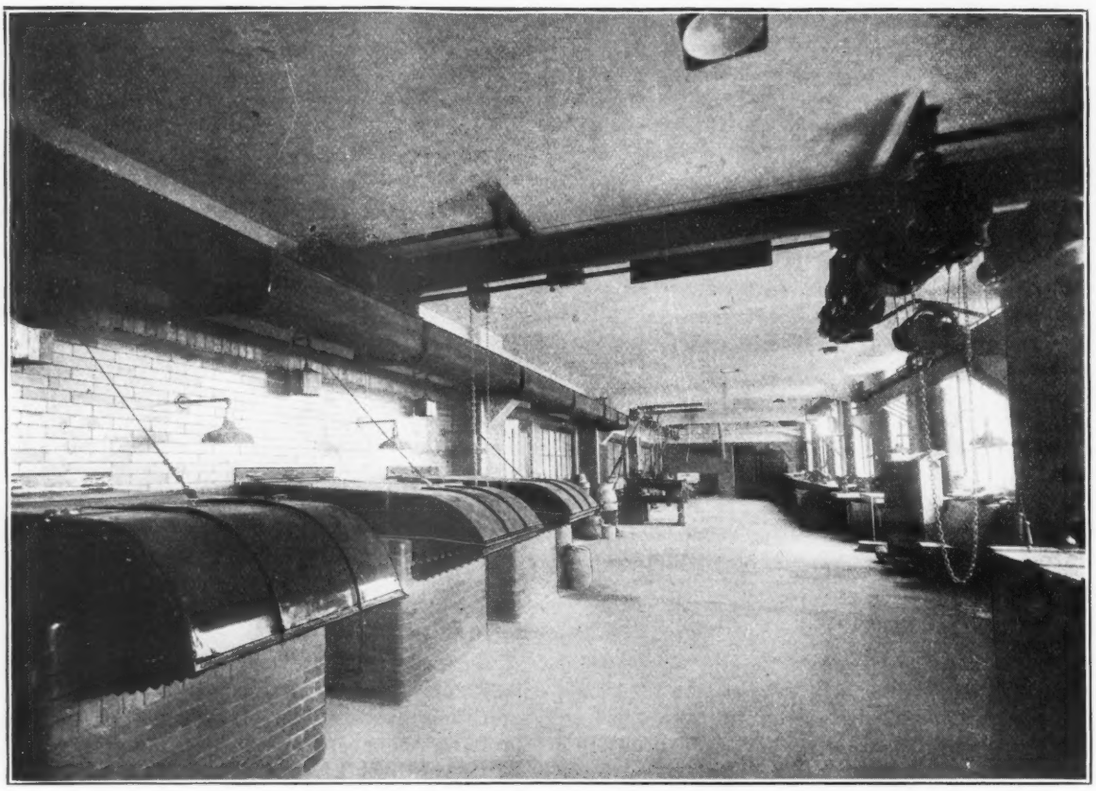
The great advantage of this plan is, of course, the flexibility of operation. It is clear, also, that, in the event that new machines are developed, they may be introduced into the flow sheets without necessitating alterations in the plant that would be required if the equipment were permanently installed. In the same way obsolete machines can be set aside with the minimum of trouble.

The equipment provided up to date is designed to test iron ores, but if it should be found desirable to experiment with ore requiring entirely different treatment the permanent parts of the plant would serve the purpose just as efficiently. So far as I am able to ascertain this is the first time that a large-scale testing laboratory has been built on these lines.

Although the feature of elasticity just described is probably the most interesting thing about the plant, the whole building is designed and equipped with a view to convenient and efficient ore testing. Most of the work will be done on lots of ore ranging from five to twenty tons. The top floor of the taller part of the building is used for receiving consignments of ore. A one-ton



View of the main testing theater. The equipment is not permanently installed, but each machine, with its motor, is mounted on a movable frame



Sample room, showing crushing and pulverizing machinery and the steam driers
The completeness of this department is typical of all the others

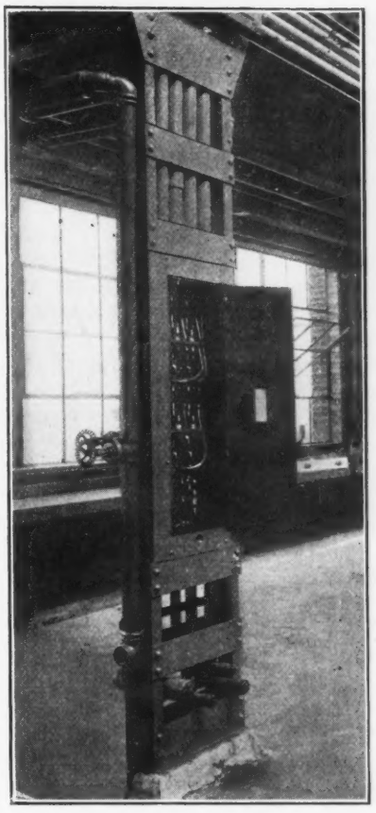
self-dumping electric truck is used to carry the ore from the railroad siding adjacent to the plant to a ten-ton elevator on which the load (including the truck) is lifted to the top of the building and dumped into ten-ton steel receiving bins, of which there are ten. As the ore gravitates through the plant it can be crushed, rolled, screened, and sampled, as desired, being finally delivered to one of twelve ten-ton storage bins from which belt conveyors are arranged to carry it to the testing theater. The conveying system is well designed and flexible.

In the basement are the sample grinding department, the assay and analytical laboratories, machine shops, and carpenter shops. Ample provision is made for repairing and maintaining the equipment in first-class condition.

On the next level below, the sub-basement, are situated the ventilating equipment, electrical equipment, blowers, compressors, pumps and similar adjuncts to the main testing plant. These are all run by electricity and operate under remote control, the starting buttons being situated on the main floor. A disposal system through which tailing and other discarded material gravitates to waste is a feature.

The right-hand wing of the building as seen in the photograph is a furnace room 32 ft. high with a molding-sand floor; it is served by an overhead crane. This department is not yet completely equipped. The offices, including computing, clerical, drafting, and filing, as well as executive departments, are housed in the left-hand part of the building.

The plant, which, with the equipment, cost $300,000, is of the factory type of construction. The walls are of brick and concrete; the roof is of steel and slate; the floor of concrete and asphalt mastic. The over-all length is 280 ft. and the width 60 ft., giving a total content of 1,000,000 cu.ft. It is an attractive building, pleasantly situated on the bank of the Mississippi; yet it is not in any sense unduly elaborate or ornate. It was designed under the personal direction of E. W. Davis, superintendent of the Mines Experiment Station of the University of Minnesota, at Minneapolis, after he had visited all of the important testing plants in the country. It impresses me as being ideally suited for the work for which it is intended. Complete, self-contained, flexible, convenient, and substantial, it cannot become antiquated as progress is made in the development of ore dressing and metallurgy.



One of ten pillars where connection can be made to electric lines, and air, water, and steam pipes

An Estimate of the World's Mineral Reserves

AT THE opening of a new laboratory of the Technical High School, at Delft, in the Netherlands, recently, Professor H. ter Meulen, the well-known economist, made a speech which seems to have been received with general interest in Holland, according to the London *Metal Bulletin*. He claimed in effect that the world's mineral resources, including ores, were being rapidly exhausted, and that it would devolve upon scientists to discover means of maintaining civilization.

The professor remarked that "the earth is rich, but not inexhaustible, and we can ask how long its wealth will be available before our descendants will find the storehouse empty. We must in this connection differentiate between living and mineral products. Unlike the former, the latter are irreplaceable." Giving statistics of the output and consumption of metals, the professor remarked that the bulk of available returns related to the pre-war period. He pointed out that the tin output had grown 3½ times in 33 years, that of nickel 300 per cent in 13 years, lead 166 per cent in 28 years, copper 335 per cent in 26 years, and the 1913 output of zinc was more than double that of 1900. As regards iron production, this increased on an average about 6 per cent annually between 1910 and 1913.

Professor ter Meulen presented the accompanying table to his audience.

Discussing the figures, the professor remarked that he had only taken into account the estimated reserves of already existing mines. He did not doubt that fresh discoveries would be made, since up to the present time the exhaustion of European mines had been compensated by finds in other parts of the world, and large areas of Asia, Africa and Australia were still comparatively unexplored. But even assuming the new deposits to amount to ten times the extent of the present known reserves, and assuming further that the annual output only doubled itself meanwhile, within a century all the ore reserves would be exhausted. As regards iron, this would be available for somewhat longer, perhaps for one or two centuries.

Metal	Estimated Reserves in Existing Mines Tons	Annual Output (1913) Tons	Period of Exhaustion, Years
Tin	2,250,000	132,000	17
Nickel	550,000	30,600	18
Lead	12-20,000,000	1,183,000	17
Copper	8,500,000-11,000,000	982,000	11
Spelter	17-20,000,000	1,000,000	20

Electrolytic Zinc Co. Completes Constructional Program

The report of the Electrolytic Zinc Co. says that the output of the works in the twelve months ending June 30, 1923, was 31,283 tons of electrolytic zinc, silver-lead products containing 4,344 tons lead and 691,052 oz. silver. Constructional program for the full zinc plant has been completed, except for modifications required to embody the improvements developed as a result of the research activities. Further blocks of electrical energy were taken in instalments until March 31 last, when the full 30,000 horsepower contracted for was absorbed, and, in addition, was delivered on July 20.

Mining Ocher at Cartersville, in Georgia*

By W. M. Weigel
Mineral Technologist, U. S. Bureau of Mines

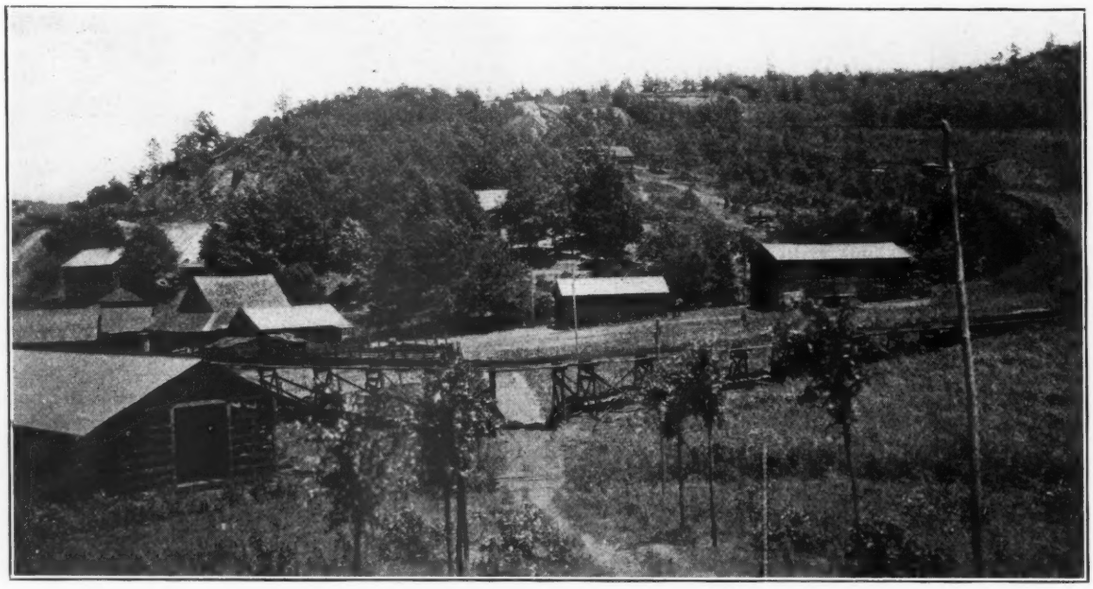
This District Is the Principal Domestic Source of the Mineral — Used Mainly as a Filler for Linoleum

OCHER was first produced in the Cartersville district of Georgia in 1877, and there has been a gradual increase in development and production since that time. Production statistics are not available, but the output of ocher for the state is probably not far from 12,000 net tons per year. Only three plants have been producing to any extent recently. They are the Georgia Peruvian Ocher Co., the new Riverside Ocher Co., and the Cherokee Ocher Co. Several other properties have produced in recent years, but their activities were of less importance.

The ocher deposits occur in a belt six to eight miles long lying in a nearly north and south direction about one and one-fourth miles east of Cartersville and beginning at a point about two miles south of the Etowah River where this stream cuts across the belt of Weisner quartzite. The extreme width of the belt is less than two miles. The ocher deposits outcrop in the valley of the Etowah, and it is in this vicinity that the most extensive, and the only important, development has been accomplished. The ore is present only in the Weisner quartzite, and all outcrops and developments indicate that it occupies an extremely shattered zone of this formation.

In some places the ore is found in veins in the fresh, unaltered rock, and in others in the clays and altered residue derived from the decomposition of the quartzite. As to the mode of origin of the ocher, the following extract is from U. S. Geological Survey Bulletin 213, by C. W. Hayes and E. C. Eckel:

"It seems probable, therefore, that the iron oxide is a direct replacement of silica. The faulting of the region, by fracturing the rocks, afforded favorable conditions for the percolation of surface waters to great depths, and since the faulting was doubtless accompanied by the development of considerable heat, the region was probably characterized by numerous thermal springs. . . . Under great pressure and at high temperature, silica becomes one of the readily soluble rock constituents. It appears that, under certain conditions, a carbonic-acid solution of iron carbonate, meeting an oxidizing solution, precipitates its iron as hydrated ferric oxide and at the same time dissolves silica."

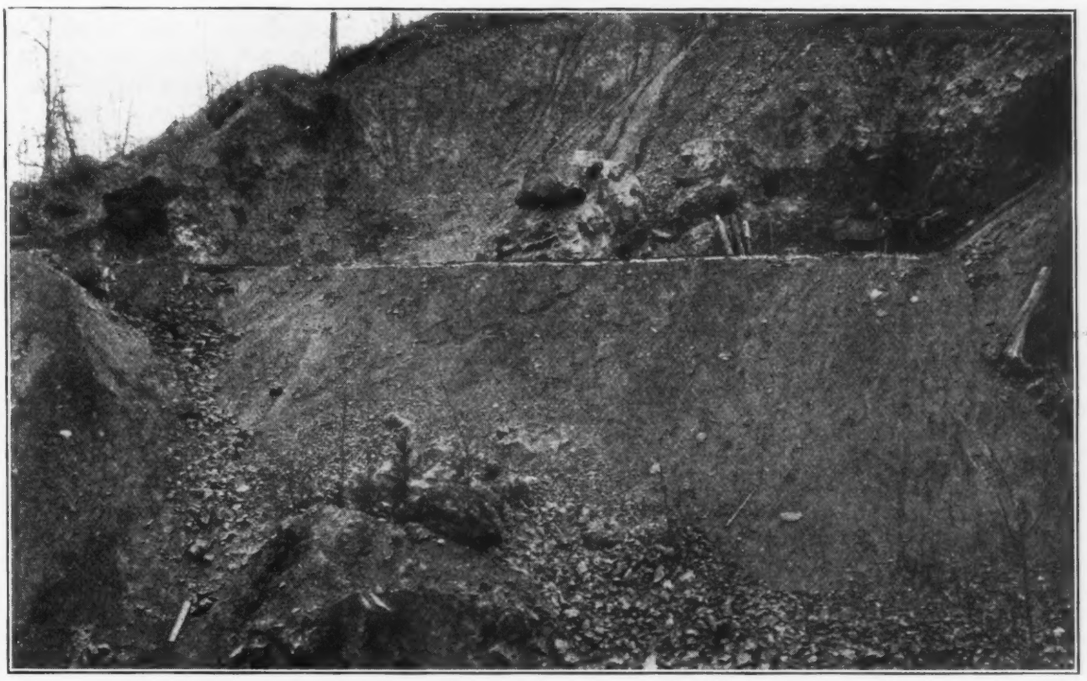


View of the hill from which the Georgia Peruvian Co. mines its ocher. The main mill building is to the left

The mill and mines of the Georgia Peruvian Ocher Co. are about two miles southeast of the town of Cartersville, on the south bank of the Etowah River near the highway bridge across that stream. Ample exposures of the ocher-bearing formations are here available on the abrupt hills resulting from the cutting through of the Weisner quartzite by the river.

The ocher in general forms an irregular network of veins in the quartzite, many of which, however, are not rich enough or large enough to work. Formerly the ocher was largely mined from open cuts near the base of the hill. These had to be abandoned when the overburden became excessive, and now all mining is carried on underground. The vein or bed being worked strikes approximately northeast and southwest, paralleling the hillside, and as far as developed the dip, to the northwest, conforms to some extent to the slope of the hill. Toward the top of the hill the orebody flattens,

*Abstracted from Serial No. 2,477 *Reports of Investigations*, U. S. Bureau of Mines.



Old open-cut workings and mouth of the adit through which the Georgia Peruvian Co. mines ocher

and follows the slope approximately down the hill; it flattens again at the foot, apparently dipping under the river in a northwesterly direction. The greatest dip on the hillside is about 40 deg. That part of the vein good enough to work is 12 to 40 ft. thick and is overlain with 50 to 80 ft. of cover. The footwall is quartzite, locally called sandstone, altered to some extent, and the overburden consists almost entirely of decomposed quartzite and clay.

The vein is reached by tunnels driven through the overburden at vertical intervals of 50 ft. On reaching the ore, drifts are carried along the footwall and raises put up about every 50 ft. The ore is stoped by beginning at the top, putting in square sets and working down the dip. It is shoveled down the raise into a loading chute for the mine cars.

The raise is never filled with ore. All available waste is stowed in the square sets to help hold the ground, which is very heavy and requires timbering close up to the face in stopes and drifts. Tunnels and drifts are timbered with sets 4 ft. apart. Round timbers 8 to 10 in. in diameter, hand flattened, are used. Timbers last only two to three years, so if possible all ore recoverable from one tunnel and set of drifts is removed before retimbering becomes necessary. Numerous tunnels are driven in from the hillside, as, on account of the short distance from the surface to the ore, it is cheaper to work different parts of the vein through a number of openings than to maintain main haulageways and permanent tunnels. One-ton ore cars on tracks of 18-in. gage are used; they are trammed by hand and mules.

Preparing and Washing the Ocher

As mined, the ore consists of a mixture of quartzite fragments, clay, sand, some barite, and the ocher more or less pulverulent. As delivered to the washer it contains 30 to 40 per cent ocher. The preliminary treatment is the same at all plants. The ore is delivered either by gravity through launders from the mine, if above, or by inclined hoist if below the head of the washer. At the washer the ore passes first through a grizzly, where all large rock fragments are discarded. Water under pressure is used to assist the ore through the grizzly and wash off ocher adhering to coarse rock.

From this the ore passes to a single 26-ft. log. The coarse discharge as it leaves the log is raked over a fine screen, about 12-mesh, and is subjected to water sprays to remove the last of the ocher. From here it is sent to waste. The fines through this screen pass over settling boxes and join the overflow from the log containing the ocher held in suspension. This now flows through about 150 ft. of wooden launder of rectangular section, approximately 10 in. square, and set with a slope of $\frac{1}{4}$ in. in 16 ft. The sand not removed in the log settles here and is continuously shoveled out by hand and thrown away. The washer has a capacity of two to three tons per hour.

Ball Mills Used in One Plant

From this point on the operation of the plants differs in considerable detail. At the Georgia Peruvian Co. plant the ocher-laden solution from the settling troughs is lifted by a centrifugal pump to a higher level, so that it flows by gravity to the finishing plant about one-eighth of a mile distant. Here it is received in a Dorr thickener and the thickened pulp is discharged from the bottom and fed to a Hardinge ball mill. The ball-mill discharge goes to an agitating tank which supplies the feed to four 4x10 ft. film-action steam driers. The dried ocher drops from the driers to an 8-in. screw conveyor delivering to a pit, from which it is elevated by bucket elevator to a bin, whence it is fed to a disintegrator or pulverizer in order to break up all lumps

formed in drying. From the pulverizer the ocher passes to a small bin over the packer, where it is packed in paper-lined barrels holding about 450 lb., or in burlap bags.

The Dorr thickener is 10 ft. high by 26 ft. in diameter and has a capacity of thirty tons of solids per ten hours. The operation of the thickener is reported as satisfactory. The overflow is clear and goes to waste without appreciable loss of ocher in it.

Dried on Steam Cylinders by Film Action

The film-action driers consist of steel cylinders 4 ft. in diameter by 10 ft. long, with a smooth outside shell free from rivets or bolt heads. They rotate slowly on trunnions at each end. Live steam at 60 lb. pressure is supplied to the interior. The thickened pulp is sprayed against the bottom by a large number of small jets. Part adheres to the hot shell and the excess is returned to the supply. The speed of rotation is such that by the time an element of the surface has passed up over the top and down nearly to the bottom the film of material is dry. At this point it is removed by a scraper pressed against the drum shell.

Methods Are Improved

The introduction of a thickener is a marked improvement over the older method of settling the ocher in tanks. A more uniform product is obtained, and there is considerable saving in ocher. It is possible that a higher recovery of ocher could be obtained by coarse crushing or cracking the lumps not broken up in the log washer. The place to do this, however, would be ahead of the log, the crushed material going to it along with the rest of the ore. No fine crushing would be permissible, as it would introduce more sand into the ocher. Coarse crushing might release seams and pockets of ocher inclosed in the larger rock fragments.

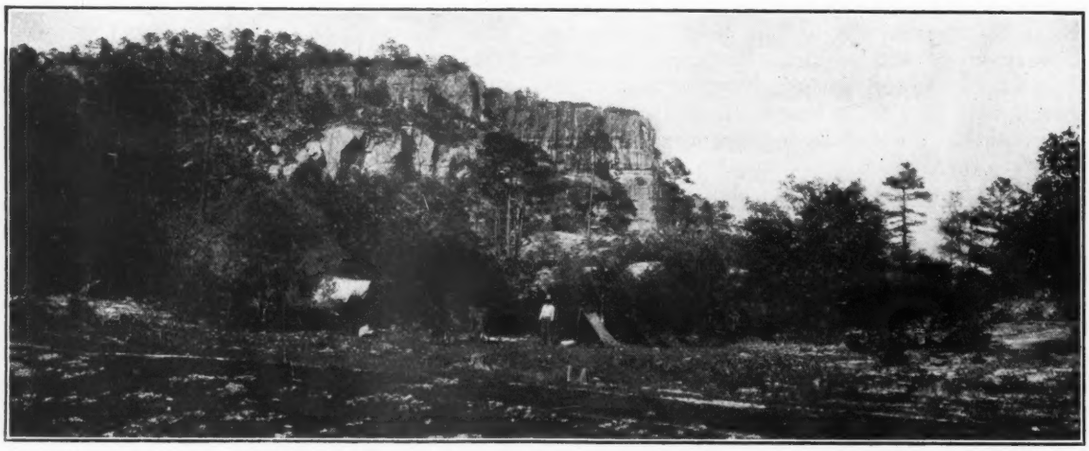
Settling the fine sand in a long launder requires a man to shovel out the settled material, and introduces the personal element in that this man must keep the launder uniformly clean and of even cross-section. A suitable mechanical classifier might take the place of the settling troughs with advantage to the product. As the finished product should be as fine as possible—about 98 per cent through 200 mesh—and the object of grinding is to reduce all coarse particles, it is probable that the use of a tube mill instead of the Hardinge mill would be an advantage. Most of the coarse grains—those larger than 300 mesh—are quartz and mica and theoretically their elimination should be effected rather than their reduction.

Dried Slime Is Finished Product

At another plant, the ocher-laden water from the washer and settling launder is run into a series of settling tanks, from which, after standing, the excess water is siphoned off. The thickened ocher is shoveled into wheelbarrows, and transferred to two long rows of drying vats. These are arranged along each side of a horizontal belt conveyor. The vats are 12 to 15 ft. square by 3 ft. deep, and have coils made of 1-in. pipe covering the bottom. When a vat is filled with ocher sludge, steam is passed through the coils, evaporating the water and drying the ocher. It is then shoveled by hand into the conveyor alongside. The conveyor first delivers to a disintegrator to break up the large lumps. The ocher then passes to a pulverizer and by screw conveyor and elevator to a sheet-steel bin over the packing floor. Barrels and bags are customarily used for containers.

Market, Uses, and Characteristics of Cartersville Ocher

A large part of the ocher produced in the district is exported for use as a filler in the manufacture of foreign linoleum and oilcloth. The rest is mainly used for the same purpose in the United States. Cartersville ocher is considered as unequaled in the linoleum industry. This is probably due to the fact that while it is as finely divided as imported ochers, it has a strong color and lower oil absorption than that from most other localities. It is used as a paint pigment, where its lower oil absorption is of value, but in color it is darker than the high-grade French brands. This is sometimes raised as an objection to its use. Generally it works quite well with linseed oil and other paint vehicles and combines satisfactorily with other colors. Its darker color, sometimes with a slightly greenish tint, is probably due to its manganese content, as it contains about 1 per cent manganese dioxide.



Divisidero, Western Chihuahua, about thirty miles from Creel, where the Kansas City, Mexico & Orient Ry. reaches the brink of Tararecua, on the Barranca del Cobre

Copper from Tanganyika

By T. A. Rickard

OUR COPPER OPERATORS may be interested to hear something about a British-Belgian company in Africa that threatens to compete with them in the markets of Europe. The output of copper from the mines of the Union Minière in July was 5,720 long tons, or 12,802,800 lb. In June the output was 4,810 tons. That portends an annual production of about 150,000,000 lb. of metal, which is about what the Utah Copper Co. is producing at this time. However, although the output of the Union Minière in July was the biggest as yet made by that company, it is expected that a larger quantity will be forthcoming in the near future. This prompts inquiry into the history of the enterprise. It was organized in 1899 to exploit copper deposits in the Katanga district of the Belgian Congo, just over the Rhodesian border and not far from Lake Tanganyika, in central Africa. A British company, named the Tanganyika Concessions, was formed to hold a 45 per cent interest in the Union Minière du Haut Katanga, the Belgian company that owns the mines. These cover a belt, 250 miles long, of copper deposits in shale and sandstone, as well as dolomite. The Rhodesian railway was extended to the mines in 1910, and an early effort was made to construct a more direct route to the coast, westward to the Atlantic, at Benguella. As yet only 325 miles of track has been built and operated out of the total distance of 1,050 miles.

IT IS STATED officially that 68,000,000 tons of ore has been developed, and that this assured reserve contains 4,500,000 tons of metallic copper, or 6.62 per cent. This estimate covers only 10 miles out of the 250 miles of the copper belt; therefore, it was stated by the managing director, 40,000,000 tons of copper is "a very conservative estimate for the whole 250 miles." This is symptomatic of the optimism that has pushed this enterprise from the beginning, for it has been directed and controlled chiefly by the gentleman whose words have been quoted: Mr. Robert Williams. He was the pioneer of this mining adventure and it is due to his indomitable spirit, and to his engaging qualities as a man, that the enterprise has sailed safely through the squalls of misunderstanding and the shallows of financial depression. From the first the effort to obtain a co-ordination of effort between the Belgian and the British directors has been difficult; again and again it was found that fresh working capital had to be raised; repeatedly the sanguine promises of those in control have been falsified; nevertheless the sincerity of purpose and the unconquerable energy of Mr. Williams have saved the day. In the early stages of this undertaking the ratio of technical advice to financial responsibility was disproportionate. The amount of money at stake called for the aid of experts in this branch of copper mining, but such aid was not solicited. To that fact is owing the belated character of the accomplishment. In 1910 the statement was made that "within three years" the production of copper would be "from 60,000 to 90,000 tons of metallic copper per annum." The smaller of these limits has only been reached after thirteen years of toil and trouble. It was assumed that Lake Superior costs could be duplicated and that copper could be delivered in London from Central Africa at 6c. per pound; and that at a time when the cost of European coke was $50 per ton delivered in the Congo! However, as I have said, these flamboyant forecasts are forgiven, if not forgotten, now that the enterprise is fairly on its feet. The Union Minière paid a dividend of 35 fr. per share for the year 1922, but this unfortunately, owing to the unfavorable exchange, yielded only £60,000 for the British shareholders.

IN THE LAST RESORT the productive life of a mine depends upon its ore resources. These have not failed the Tanganyika Concessions, but much more ore remains to be developed. Besides the copper, the concessions cover veins of gold, tin, and radium. Since January of this year the uranium deposit of Chinkolobwe has been yielding radium "on a scale sufficient to cover amply the requirements of the whole world" —so states Mr. Williams. In the first five months of the current year 302 tons of cassiterite was produced. A tin refinery is operated at Hoboken, in Belgium. From the Ruwe mine $500,000 in gold has been taken already. Coal mines, which produced 30,000 tons last year, are being opened up at Luena, in Katanga. At the Ruachi mine 5,000,000 tons of 10 per cent copper ore, including 1,500,000 tons of 19.3 per cent ore, was developed in 1922. Notable extensions of the known orebodies are being proved. The prospects of favorable developments are unmistakable; the operations are not confined to a mine or even a group of mines, but to a large district rich in a variety of ores and metals. In 1922 the production of copper was 43,362 long tons; during the first half of 1923 it was 24,528 tons. A leaching and electrolytic precipitation plant of 30,000 tons' capacity per annum is about to be built, as an annex to the smelter, which is at Lubumbashi. When the Benguella railway is completed, the progress of mining in Central Africa will receive a great impetus, because it will give ready access to mineral regions of many resources, notably Angola.

AT THE ANNUAL MEETING of the company Mr. Williams referred to the time, thirty-two years ago, when he first explored this region for Cecil Rhodes, and traveled 1,500 miles by wagons and on foot from a sand-pit at Beira, where now there is a flourishing port. The prospectors who found the copper deposits tramped 1,000 miles into a country where cannibalism still survived. In this wilderness there have been built well-ordered towns and attractive homes; thousands of natives are happily employed, railways have been built and a varied commerce has been established—in short, a new civilization has been established where not long ago cannibalism, slavery, and disease reigned supreme. For this the miner deserves credit; the pick followed the flag and turned an empty conquest into an industrial achievement. Of all who participated, Robert Williams was the chief, but it is pleasant to record that one of the earliest reports forecasting the importance of these copper deposits was made by Mr. John R. Farrell, now a resident of Oakland, California. Another American technician connected with the enterprise is Mr. A. E. Wheeler, formerly of Great Falls, Montana, who is now consulting metallurgist to the Union Minière.

DISCUSSION

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

Effect of Fissure Narrowing

THE EDITOR:

Sir—The essay on the "Gold Ores of Porcupine," by J. E. Spurr, in your issue of Oct. 13, is so arresting as to demand careful scrutiny *lit par lit,* but the admirable logic characterizing the presentation moves me to challenge one flaw which so pervades the literature of ore deposits that it has finally acquired a standing in the company of its betters to which it is entitled by neither birth nor breeding. I refer to the effect on ore deposition of the "damming" or "impounding" of solutions.

In his paper Spurr remarks (p. 637): "Yet good ore in quantity may in places occur just under the porphyry, where an ore-bearing fissure intersects the contact, as in the Dome, whence Mr. Wright infers there a previous decomposition and softening of the porphyry, so that it obstructed and dammed the ore magma solution."

W. Lindgren ("Mineral Deposits," 1913, p. 176) affirms the effect, but reserves any explanation of the cause, in these words: "It is not entirely clear why deposition of rich ore should take place when solutions are impeded and partial stagnation follows, but the conditions observed bear sufficient testimony to the fact."

Now, the ready currency of the dam concept can be traced, as I see it, to its associations with the familiar tailing pond where the swift flow from the launder is retarded by the *dam,* causing *stagnation* with the *deposition* of sand and slime, but this is a mechanical process, and sedimentation bears no analogy to the deposition of minerals from solution. On the contrary, it can be shown that while stagnation promotes mechanical deposition it inhibits chemical precipitation, and the terms appropriate to the one process are misleading when applied to the other.

In all cases where ore deposition is conditioned by the wall rock, whether the principle be supersaturation, adsorption, chemical interchange, or what not, it may be regarded as a function of the surface of contact between the solution and the rock.

The recurring assertion or implication that a barrier impedes the flow in its vicinity is erroneous, since obviously in all parts of a conduit the volume of liquid passing in a given time is constant, regardless of the area of cross-section. The velocity of the flow is in inverse proportion to the cross-section of the conduit. The relation of surface to volume can be expressed in the simplest terms by considering a volume V per unit of time flowing through a large pipe of diameter d' reduced to a small pipe of diameter d''. When the surface of the large pipe in contact with the unit volume of liquid is represented by S' and the contact surface of the unit volume in the reduced pipe is S'', we find the ratio $\frac{S'}{S''} = \frac{d''}{d'}$ —that is, the surface exposed in unit time to a liquid flowing through a conduit of variable caliber is inversely proportional to the diameter of the conduit. Referred to the case in hand, this means that where a channel through which a solution ascends becomes contracted, the velocity increases and the amount of solution in contact with unit area of rock in unit time increases. Hence, it follows that contraction promotes chemical or physico-chemical reaction between solution and wall rock, and this effect is produced by acceleration of the flow and not by stagnation, as is commonly implied.

The foregoing attempt at a more rigorous scrutiny of a familiar phenomenon in no wise explains the concentration of rich ores at barriers, but an eventual elucidation of the occurrence will only be delayed by further use of such terms as damming, impounding and stagnation, with their erroneous implications. In their stead I propose the term ***constriction,*** which records a fact while avoiding any connotation of cause.

London, England. HENRY H. KNOX.

Stabilizing the Copper Market

THE EDITOR:

Sir—I read your editorial "A United States Copper Corporation" with a great deal of interest. It seems to me, however, that the same end—namely, the normalization of the disorganized copper market and the stabilization of the copper industry—may be reached in a different manner.

My suggestion would be a concerted action of the copper producers in reducing the scale of production. It is true that such a measure might do more harm than good, if applied in the wrong way. If, for instance, the copper producers should agree to reduce the output of their plants to a certain percentage of their producing capacity, until the demand for the metal would call for an increased output, this would remove competition to a large extent and with it the foundation on which our economic laws rest. Besides, such a measure would be a great deal more advantageous to the high-cost than to the low-cost producer, and the latter would naturally object. Nevertheless, the low-cost producer would also benefit from a reduction in output, although to a smaller extent, and it seems to me that it should be possible to find a basis on which all mining companies, high- or low-cost producers, would equally benefit from a reduction in output.

Suppose, for instance, Chile Copper produced copper at 6c. and Inspiration at 12c. Copper should certainly not sell for less than 15c. under present conditions, and efforts to raise the price to that figure are in order. At 15c. Inspiration would, therefore, earn 3c. against 1c. at 13c. and should stand for a large reduction, say to one-third capacity, while Chile would earn 9c. against

7c. and could cut down the output somewhat, say to seven-ninths of its capacity.

It goes without saying that these figures are meant only to illustrate the principle, but it should be possible to find a suitable modification that would be to every producing company's advantage.

But would it be to the advantage of the people as a whole? It would appear that a periodic demoralization of an important industry is harmful to the country at large and that any sane plan that would prevent the paralyzation of busy mining communities every few years should find due consideration.

There is some danger of overdoing the thing, of course, and every step of this kind should be carefully watched.

I do not know whether or not legal points prevent the application of such a remedy to a sick industry. If they don't it would seem that some such plan should be adopted without delay. Perhaps it is one of the things that, like the chaos in Europe, might be straightened out to everybody's advantage if those concerned could be made to abide by the recommendations of some impartial commission. RUDOLF GAHL.

Berkeley, Calif.

An Interesting Occurrence of Rich Ore

THE EDITOR:

Sir—One could hardly call it ore; in the terms of the Lake Superior copper miners, it would be "gold rock." The discovery was made in the early 80's at a time when some interest was being taken in gold mining in the vicinity of Ishpeming and Negaunee, in Michigan, the home of the first iron mines on the Lake Superior ranges.

The first gold mine, the Ropes, was being operated with twenty-five stamps dropping (later forty were added), the gold being recovered by amalgamation followed by concentration on Frue vanners. This sent men into the hills, and one result was the discovery of a quartz lode about four miles west of the Ropes mine, near the northern margin of the diorite belt. Samples from this discovery, the Michigan mine, did "stir things up," for the rock was a pure white sugar quartz with the texture of Carrara marble, with stringers of gold in nuggets and a veritable network through it. I recall pieces as large as one's fist which were cracked through in several directions, the sections being held together by the gold. Assaying was perfunctory on such as this, but returns ran $70,000 and upward per ton.

A Huntington mill was put on this. The pocket of gold ore was of no great extent, and but one other, a small one, was found. The lode has since been operated as a "silica mine," shipping pure silica to the steel plants. "High grading," even in those days, resulted in the arrest of two or three men who had been employed at the mine and were on the point of taking a vacation. A trunk containing about 400 lb. of this "rock" was found among their baggage, but, "technically," it could not be proved that it was ore from the Michigan, so they were released.

There was no other metal or mineral in the quartz, it appearing as a piece of pure marble threaded with gold. The ore at the Ropes mine was quartz of a dark color and contained other ores in small, associate amounts—galena, tetrahedrite, "resin" zinc, chalcopyrite, which were concentrated to, in the latter years, from $35 to $40 per ton. The large percentage of gold and silver was recovered by amalgamation even on ores mined at 800 to 900 ft. depth.

Mr. Rickard's interesting sketch, "Concerning Rich Ore," recalled the above to mind; also Mr. Spurr's very profitable descriptions of Porcupine and Kirkland Lake gold occurrences. The Ishpeming gold belt, in the ancient "Laurentian" hills, lies about four miles north of Ishpeming and the iron range. The Michigan lode was in the diorite. The ore at the Ropes mine occurred in lenses between serpentine schist, lying on the north or footwall, and massive serpentine—verd antique "marble"—on the hanging wall. With the quartz-gold orebodies there were lenses of dolomite. Dolomite, of which a large outcrop occurred on the east "forty," had been quarried for some time and used as flux in the Deer Lake charcoal iron furnace two miles or so south. At present, Carter Bros. are quarrying the verde antique on the forty immediately to the west of the Curry shaft of the Ropes mine. The production, in the course of milling operations, was $647,000 up to about 1895, which was augmented by $107,000 recovered by cyanidation of the tailing in 1898 and following years. The latter was one of the early, cyanide plants in the United States. The showing was a good one, considering that the mine was "in an iron district and gold could not exist."

During the same period, several of those who were interested in the above-described property and in other gold operations in the vicinity were also connected with the gold discoveries and development in the Rainy Lake and Sein River fields referred to by Mr. Bramble in the issue of Sept. 1 of the *Engineering and Mining Journal-Press*.

The first ore vein was discovered on the Ropes mine on May 17, 1881, and the larger vein was that which was mined in August of the same year. Later, while learning to "blow-pipe," I determined nickel from samples of genthite and garnerite taken from seams in the serpentine belt not far from the gold mine. Ruminating over these episodes of the past I am tempted to let myself "dream" into the future; to compare present with past geologic theories, to note analogies between the old and the more recent developments of the Ontario silver and gold camps, and wonder if there is not still justification in predicting that the old will revive. L. S. ROPES.

Helena, Mont.

Fine Grinding in Ball Mills

THE EDITOR:

Sir—The recent article by Arthur B. Parsons in the Sept. 22, 1923, issue regarding rubber lining for ball mills, as used at Nipissing, and that of H. W. Hardinge, in the Oct. 13 issue, has inspired the thought as to where and how the actual fine grinding in either a ball or rod mill takes place.

The admirable work of Mr. Denny in lining a tube mill with rubber removes the much vaunted idea that a considerable portion of the grinding takes place between the charge and the shell of the mill. The recent tendency to reduce the speed of tube mills clearly indicates that the cascading of the grinding media at higher speed is not essential except where the mill operates on coarse feed.

The fact pointed out by Mr. Parsons, that in a

rubber-lined mill the charge rides up higher and consequently exposes a longer grinding surface than with an iron or steel lining, seems to prove that the fine grinding is more of a shearing or triturating action than the rolling motion that is secured in ball and rod mills.

Mr. Hardinge's statement that there is less abrasion of the grinding media in the line contact is quite true, but does this not reduce the grinding efficiency? The ideal condition would be a very fine layer of ore between the grinding media. Does the rod mill give this ideal condition? We all know that we would not use a roller to pulverize samples upon a bucking board. Why? Simply because the arc of contact between the roller and the bucking board would be too large. The arc of contact between the muller and the bucking board is much smaller and consequently closer to the ideal condition. This leads me to the belief that sphere or rod is not the most efficient grinding media for fine grinding. If it were possible to have a series of mullers, such as are used in an assay laboratory, working one upon the other, they would appear to be an ideal media for fine grinding, as the surface of the charge would form the bucking board and as the angle of repose was exceeded in rotating, the individual mullers, in sliding over the top of the charge, would produce a grinding or triturating action the same as is accomplished on a bucking board, in addition to which the shearing action of the charge within itself causes additional but more intensified triturating or shearing action. Therefore, I do not believe the rod mill is the ideal for fine grinding, because it is practically impossible to keep the rods rolling parallel to one another, to say nothing of wearing uniform. It seems to me that the greater abrasive power the media exerts the greater the grinding efficiency of the mill, and for this reason disk-shaped media should give better results.

Mr. Hardinge hit the nail on the head when he said that it is a question of which is the most economically efficient. It is really a question of cost per ton of ore ground, which is the deciding factor.

I well recollect the time when the Hardinge conical mill first made its appearance. Hardinge was the first to adopt the larger diameter and the short mill. There were a great many skeptics. We have to admit, however, that the Hardinge mill is a success and he was the pioneer who blazed the way to the short mill of the present day, whether ball, rod or any other type. Possibly some slight change in the shape of the grinding media as simple in comparison as the conical mill is with the tube mill may bring about a much greater efficiency. Possibly, also, Mr. Hardinge, who has the facilities, will favor us with the results of some of his experimental work showing screen tests of various-shaped disk grinders in comparison with ball and rod mills under similar conditions.

Mr. Denny's idea of lining tube mills with rubber undoubtedly will have an important bearing on the media used. With the elimination of the skidding of the charge against the lining of the mill, and the consequent higher point to which it is raised before it overcomes the angle of repose, there appears to be a new element. To me it seems to be a shearing or sliding of the charge over itself, both on the surface and close to it, which may vitiate previous practice and point the way to an entirely new shaped grinding media and consequent greater efficiency.

New York City. ARTHUR E. FEUST.

Effect of the Earthquake at Japanese Mines

THE EDITOR:

Sir—I shall be glad of any information regarding the effect of seismic disturbance on mine workings.

The Toi gold mine, of which I am in charge, is situated on the mountainous western coast of the Izu Peninsula, in Japan, and is roughly 30 miles due west of the position officially given as the center of the disastrous earthquake which occurred on Sept. 1. The date happened to be a general holiday, so that no men were working underground at the time. At the moment when the shock came, I happened to be standing on high ground overlooking the township and mine, and the violence of the vibrations was so severe that it was most difficult to keep my feet. Although no houses actually fell here, they were badly shaken, and the smokestack (120 ft. high) at the mine swayed in an alarming way. Having had many years' experience of rock-bursts in the underground workings of the Kolar mines in India, and being well acquainted with the great damage caused by these phenomena, I felt certain that the workings here must have been affected. I am, of course, aware that rock-bursts are the result of local pent-up pressures, and are not vibrations traveling from a distance.

I may say that this mine has been operated for more than three centuries, but the work, with the exception of that on one level, has been confined to those areas above sea level; and systematic filling of stoped-out areas has not been the general practice.

On the day following the earthquake I inspected the workings, and was surprised to find that there was not the slightest sign of damage, either in the form of opened joints or fallen rock. The veins here strike roughly north-south, and, as far as can be ascertained, the seismic waves traveled in a northwesterly direction —that is, across the strike; but it is difficult to obtain authoritative information on this latter point.

I have made enquiries, but, as far as can be ascertained, none of the other mines in Japan experienced damage to the underground workings, although, on surface, many smokestacks and buildings were razed.

Toi-Mura, Japan. J. NORMAN WYNNE.

Petroleum in Naval Reserve No. 3

THE EDITOR:

Sir—A widespread misunderstanding seems to exist owing to the fact that the daily press has mis-stated in one important respect the results of the investigations made by myself and James O. Lewis for the Committee on Public Lands and Surveys of the United States Senate. Practically all of the newspaper statements relative to the estimates of oil existing under Naval Reserve No. 3, which include Teapot dome, give the impression that the oil content has already been reduced from 135,000,000 bbl. to 26,000,000 bbl. or less. Such is not the case. Both Mr. Lewis and I referred to a previous estimate which gave 135,000,000 bbl. as the estimated amount of oil in the reserve in both Wall Creek sands, or 85,000,000 bbl. in the Second Wall Creek sand alone. Our estimates of the oil content are, on the contrary, between 12,000,000 and 26,000,000 bbl. The difference is not due to any great change in the amount of oil to the present time, but to the fact that developments now enable us to make more accurate estimates than was possible by persons making the original estimate. FRED G. CLAPP.

New York.

CONSULTATION

Anticipated Life of a Wrought-iron Pipe for Water Supply

"I would be greatly obliged if you could kindly supply the answer to the following question: What can we anticipate as the average life of ordinary wrought-iron pipe, 2-in. diameter, delivering clean water for domestic water supply? The pipe to be laid on the surface, painted with suitable material, such as coal tar, to be running full practically all the time. The pipe takes water from a small stream flowing through andesite country. The total length of pipe is 2,000 ft., and the vertical height between inlet and discharge is 100 ft. The grade of pipe is fairly even. We have frost for three months in the year. The lowest temperature in the winter months is 12 deg. below zero C.—that is, 20 deg. F. I thank you in advance for the favor of a reply, which will settle a rather heated argument."

The above inquiry, which came from a mining engineer in Japan, was referred to several prominent manufacturers of wrought-iron pipe. Replies from two of them are especially illuminating and are reproduced below. Estimates must naturally vary widely, as indicated by these letters. The first one, incidentally, gives additional interesting information about wrought-iron pipe:

"We wonder if your subscriber in Japan knows the difference between genuine wrought-iron pipe and ordinary steel, which latter is sometimes called wrought iron by those who are not aware that there is a difference between the two makes.

"As to the average life of genuine wrought-iron pipe, 2 in. in diameter, handling clean cold water for domestic water supply, we have usually found that our pipe in such a service will last well beyond the twenty-five-year mark—unless the water be so heavily charged with carbonic acid or with some corrosive salt that the life of the conveying pipe is materially shortened thereby.

"As a matter of fact, we have investigated a great many old buildings in which the plumbing and heating pipe is of our own manufacture, and we have yet to find where the cold-water line has failed under ordinary service—even after thirty and forty years of use.

"Regarding the further information which you give us, the pressure which would be created by a grade of 100 ft. would be something less than 50 lb. per square inch, and as all our 2-in. pipe is tested to a hydrostatic pressure of 1,000 lb. per square inch before leaving the mill, this 50-lb. pressure is well within the limits of safety.

"We would, however, caution your subscriber that unless the water is constantly flowing through this pipe, a temperature of 20 deg. is likely to result in the water freezing inside of the pipe. This, as you no doubt know, would split practically any ferrous material—unless some arrangement is made to take care of the expansion at the moment the ice is formed."

The following communication appreciates the difficulty involved in making an accurate estimate of the life of the pipe in question and adds to the discussion:

"It is impossible for us to give any absolute data or answer to the question you have proposed, as there are various elements which might be present that would corrode or destroy the pipe—as, for instance, though you say that the water is clean, it might be charged with gases and elements that would cause rapid corrosion, or the soil itself. . . . may be charged with such corrosive elements. In case that neither the water nor the soil is impregnated with corrosive elements, nor the pipe laid in position where it would be subject to the salt air and fogs from the sea, good wrought-iron pipe used for this purpose and protected in the way you mentioned in your letter should last almost indefinitely. The pressure from the head of water mentioned would not strain the pipe in the slightest, as such pipe in this country is frequently used under much heavier working pressures. We have given you the best reply we can to your questions and trust it may be of service to you."

Production and Outlet for Strontium Minerals

"I would like to have some information regarding the amount of strontium produced in the United States from domestic ore and the field for the strontium-bearing minerals."

No strontium ore is mined in the United States, according to government statistics. All of it used is imported. In 1922 most of the strontium chemicals manufactured in the United States were derived from celestite, imported from England. Celestite is a sulphate of strontium. The largest production was made by the E. I. du Pont de Nemours Co., of Paulsboro, N. J.

Strontium chemicals are mainly used in the manufacture of signal lights and fireworks, and in medicines. The following quotation taken from a U. S. Geological Survey Report by George W. Stose gives detailed information about the strontium market and industry in this country:

"As strontium carbonate is a stable compound that is readily handled, stored, and shipped, a large part of the celestite is converted into carbonate by treatment with soda ash (sodium carbonate) before it is exported to this country. Strontium carbonate is extensively used in the manufacture of other strontium compounds, and considerable quantities are imported for this purpose. Strontium nitrate can be made from it by treatment with nitric acid, but much of the strontium nitrate used in this country is made by converting ore (strontium sulphate) into sulphide by roasting with powered coal and then treating the sulphide with nitric acid. Although strontium nitrate is not explosive it breaks down readily and is not ideal for storing or shipping, but by using proper containers it is imported in large quantities. It is also the chief strontium compound made in domestic plants. The nitrate is used in the manufacture of pyrotechnic red fire and lights, railroad flares, signals, and fuses, signal shells, and signal lights. Strontium bromide, salicylate, chloride, and other compounds are made for medicinal use and chemical reagents. Strontium chemicals are now made chiefly in the Atlantic States and in Missouri, and during the World War some were made in California and Washington. The demand for domestic ore is at present confined largely to the eastern states, where it must compete in price and quality with ore and strontium chemicals imported from foreign countries, chiefly from England and Germany."

Recent Technical Publications

Reviews, Abstracts, and References

Willis on Geologic Structures

Geologic Structures. By Bailey Willis. Octavo, pp. 295. McGraw-Hill Book Co., Inc., New York, 1923. Price $3.50.

This book is both elementary and advanced; such elementary matters as strike and dip are defined and methods for determining them given; and difficult dynamic problems are discussed.

Stratification, flexures, and folds are first described, with the aid of many illustrations, principally diagrams. The subjects of joints, structures of igneous rocks, and cleavage claim very short chapters. The main part of the book is devoted to faults, mechanics of rock deformation, field methods, and graphic methods and practical problems. In the chapter on faults, after a description of the nature of faults and the various kinds of fault displacements, Mr. Willis gives an interesting account of many of the great faults of the world of various types. This is followed by a rather full treatment of the nomenclature of faults, a matter which may seem unimportant, but is not; for it helps in clearing one's ideas regarding the movements that may occur and in showing how little is known of the actual movements that have taken place on any of the great faults. The author prefers to classify faults into high-angle and low-angle faults rather than into normal and reverse. This may not be convenient for miners, but dynamically it is sound. He thinks the dips of great faults diminish and approach horizontality at great depths; but his argument is by no means convincing. Under "Mechanics of Rock Deformation," after a discussion of the forces involved and the types of structure produced, the author attempts a mechanical explanation. In discussing the distribution of thrust in a fold subjected to pressure on one side in the direction of the bedding (horizontally in his diagram), he resolves his thrust into components in the direction of the bedding and at right angles to it, and makes the former gradually diminish as he goes further from the point of application of the force; and reaches the conclusion "that no effective stress can be transmitted through an actively developing fold." The complete solution of this problem is indeterminate, but an application of the fundamental laws of mechanics shows that, in the absence of other horizontal forces (which are not mentioned), the horizontal thrust at the vertex will be the same as the applied force, and will be transmitted in full. The thrust along the bedding on the flanks of the fold may be greater or less than the applied force, depending on the ratio of this force to the weight supported and on the form of the fold. This holds whether the fold is still or "active"; for the movements are so slow that the acceleration may be disregarded. There are other cases of the misapplication of the resolution of forces.

In the chapter on "Field Methods" the author gives the results of his experience in many lands, emphasizing the method of inferring geologic structure from topographic relief. The chapter on "Graphic Methods" is by Robin Willis; the ordinary methods of perspective geometry are applied to the solution of some simple problems of geologic structure. The appendix contains illustrations of the folding of artificial strata, selected from the author's paper on "The Mechanics of Appalachian Structure" in the Thirteenth Annual Report of the U. S. Geological Survey.

The book is agreeably written. Dr. Willis has had a wide field experience in many parts of the world. The best part of the book is where he gives the results of his observations; the least satisfactory, where he gives mechanical explanations. HARRY FIELDING REID.

A Textbook of Filtration. By Charles L. Bryden and George D. Dickey. 376 pages and 264 illustrations. Chemical Publishing Co., Easton, Pa.

This volume covers the general field of filtration involving the removal of suspended solids from liquids and gases. The process of filtration is becoming increasingly important in many branches of the treatment of minerals, and consequently a book of this character will no doubt be welcomed by technical men in the mineral industries. The discussion of light filters, though brief, seems quite out of place in a book of this type, for their action depends on the absorption of certain wave lengths of light, processes unrelated in any way to the filtration of suspended solids. Only thirty-four pages are devoted to the principles of filtration, the remainder of the text consisting chiefly of descriptions of various types of filtering equipment, and their mode of operation. It is of particular interest therefore to practical operators, though even in this field it is not as fully up to date as might be desired. However, the authors have compiled a vast amount of useful information on a subject inadequately covered in present-day literature, and thus have rendered a valuable service to the mining and chemical industries. OLIVER BOWLES.

Geology of the Watabeag Area. By Douglas G. H. Wright, pp. 30, 11 figures, 3 maps. Thirty-first Annual Report, Ontario Department of Mines, Vol. XXXI, Part VII, 1922.

A geological reconnaissance of an area southeast of Porcupine and northwest of Kirkland Lake. The treatment is descriptive, covering the general geology and other natural features of an area of 450 square miles. The oldest rocks are of Keewatin age: these have been intruded by siliceous rocks of Algonquin age, and these by diabase dikes. Later were deposited flat-lying sediments of the Cobalt series. Speaking generally, from an economic viewpoint, the geological work proved disappointing, for much of the area is both overlain by swamps and sandplain, and underlain by hornblende granite. Gold prospects are described at several points: small deposits, of fluorite, and barite veins.

New Patents

Cone Concentrator—No. 1,465,143. Aug. 14, 1923. J. I. Mullen, Naturita, Colo. A combination of an outer and an inner cone, forming an annular channel for grading ore particles. Suitable means are provided near the apex of each inverted cone for agitation in opposite directions.

Heater for Oil Wells—No. 1,464,618. Aug. 14, 1923. R. S. Pershing, Fort Worth, Tex. A series of coils for electrically heating oil wells, so arranged that one or more of the coils may be removed without interfering with the heating arrangement. The coils are enclosed in air-tight shells.

Hydrometallurgy — No. 1,464,036. Aug. 7, 1923. W. F. Gordon and E. W. Keith, Denver, Colo. Metallic ores containing oxides, carbonates, sulphates, and sulphites are subjected to the solvent action of gas-house liquor, the valuable metals being thereafter recovered from the solution and residue.

Metal Refining—No. 1,465,128. Aug. 14, 1923. Henry Harris, London, England. Apparatus for refining molten metal by passing it through a molten reagent. The Harris process has received considerable attention in England as an improvement in the refining of lead, and it is understood that it is being investigated by American interests.

Chloridizing Volatilization — No. 1,465,138. Aug. 14, 1923. H. R. Layng, San Francisco; Hattie H. Layng, administratrix of H. R. Layng, deceased. The ore is ground in a chloridizing solution, the surplus solution removed, the dissolved metals are precipitated, and the ore is then subjected to a heat sufficient to volatilize the remaining metals.

Roasting Furnace—No. 1,465,417. Aug. 21, 1923. B. G. Call, Tacoma, Wash., and R. A. Wagstaff, Garfield, Utah, assignors to the American Smelting & Refining Co., New York City. An improvement in the mounting of rabble blades on the rabble arms of a multiple-hearth mechanical roasting furnace, by which one rabble may be removed without disturbing the others.

Electrolytic Copper—No. 1,465,034. Aug. 14, 1923. F. L. Antisell, Perth Amboy, N. J. In electrolyzing cupriferous electrolytes, a current is passed between a cathode and several anodes, the material of at least one of the anodes being insoluble in the electrolyte and not subject to attack by the products of the electrolysis; the other anode consists of cupriferous material which is attacked by products of the electrolysis.

SOCIETIES, ADDRESSES, AND REPORTS

Nature's Architecture in South Utah

Professor Kemp Describes a Recent Trip Through Bryce and Zion Canyons at A.I.M.E. Meeting

CATHEDRALS, mosques, buttresses, pyramids, amphitheaters, spires, battleships, and bridges. These are a few of the forms that erosion has left in the sandstone hills and canyons of southern Utah. Some of them are hundreds and even thousands of feet high. In color the sandstone ranges from white to gray, and from pink to red. Green pines abound, and the sky is wonderfully blue in the clear dry air of the highland region. The scenery is magnificent, inspiring.

So far as the limitations of photography and vivid verbal description permitted, Prof. James F. Kemp, on Wednesday evening, Nov. 7, took 100 members of the New York section of the Institute over an automobile journey that he made in this region last summer. He showed excellent slides, which were loaned by J. Fred Pack, professor of geology at the University of Utah. These were colored so that they gave an accurate impression of the color effects. Although it was difficult to visualize the immensity of the shapes, as there was nothing with which to compare them, the audience was deeply impressed with the wonders of nature as an architect.

J. V. W. Reynders told of the plans of the Columbia Steel Co. to exploit the iron ores of southern Utah. He declared that the assembly cost of iron ore and coke from Carbon County (Utah) coal at Utah Lake was less than that of the same material at either Chicago or Pittsburgh. He said that the blast furnace at Provo would be in operation early in 1924.

The talk was preceded by dinner at the Harvard Club. Bradley Stoughton presided.

Mining Laboratory and Camp Maintained by Colorado School of Mines

To provide an opportunity for practical study in the field, the Colorado School of Mines maintains a mining laboratory and mine camp at Idaho Springs, Colo., fifteen miles from the School at Golden. Here excellent opportunities are offered for practical mine surveying, mineral-land surveying, geological field work, and also the underground work of sampling, stoping, drifting, drilling, and similar practical work. This district is especially rich in gold and silver, with lead, copper, and zinc in smaller quantities. Practical phases of mining are well illustrated in both shaft and tunnel operations. For study and inspection there are eighty mines, fifteen mills and twenty tunnels. The district is also well supplied with concentration plants equipped for amalgamation and concentration.

The opportunities of this camp are not restricted to Colorado Mines students. The field is large, the types of work varied and several schools can make use of the camp at the same time.

Safety Council Director Speaks at Geneva

Demonstrating the very remarkable growth of the industrial safety movement in the United States, by lantern slides, motion pictures, photographs, and posters used in accident-prevention work in that country, W. H. Cameron, managing director of the National Safety Council of the United States, addressed the International Labor Conference of the League of Nations at Geneva, Switzerland, on Oct. 22, on "Accident Prevention in America." Mr. Cameron spoke on invitation of the League of Nations. He said in part:

"The safety problem is a world problem. Its solution is of vital importance in our international industrial life. The prosperity of any nation depends on the productiveness of its workers, which in turn depends to a large extent on their safety, health, and welfare. Stopping the tremendous waste of accidents will improve the condition of industry, of the worker and of the nation as a whole.

"The quickening interest of employers, of governments, and of this great body (the League of Nations), devoted to the solution of world problems, is a most encouraging sign. With the co-operation of these forces, great strides in accident prevention are possible. I firmly believe that the time is not far distant when accidental death and serious injury in industry will be the exception. Earnest effort in reducing the casualties of peace is an expression of the highest type of patriotism to one's country and of service to humanity as a whole."

Cooley Resigns as President of Engineering Council

Resignation of Mortimer E. Cooley as president of the American Engineering Council of the Federated American Engineering Societies was announced at the recent meeting of the Executive Board of the Council held in Rochester, N. Y. Dean Cooley, in presenting his resignation to the board, said that he retires on account of ill health.

Metallurgical Education a Topic at Pittsburgh Meeting

Importance of Fundamentals Emphasized—Too Many Phases Should Not Be Followed

THOUGH metallurgical education is a somewhat well-worn topic at technical conventions, it was again discussed recently at a symposium held by the American Society for Steel Treating at Pittsburgh. It was generally agreed that specialization early in the four-year course is not good, and that considerable attention should be paid to the fundamentals of chemistry, physics, assaying, mathematics, and the like. Regarding the last subject mentioned, it has been found that many men have no idea of the definite relation of figures to objects or processes. Physical chemistry is important, but has been more or less neglected; so has metallography. Modern languages should be included in the course, and certainly engineering English.

If a fifth year is added, some study should be given in management, accounting, and finance; the higher mathematics; mechanical and electrical engineering; and history—that is, as far as it concerns the growth of metallurgy. The interpretation of what is seen—which means the observation and clear deduction—is a faculty that must be developed.

Students should not follow too many phases of engineering; they should either take up metallurgical engineering, or specialize in research metallurgy, which is a growing profession.

Funds for Raymond Memorial Assured

The committee of the American Institute of Mining and Metallurgical Engineers having in charge the raising of a fund to erect a memorial in the Engineering Societies Building to Dr. Rossiter W. Raymond announces that the full amount needed, estimated at $5,000, has been underwritten. Anthony de Francisci, the sculptor, has submitted designs for a life-sized figure in bronze relief.

Though the amount has been guaranteed, it is the desire of the committee to have as many members of the Institute as possible enrolled as participants. Members are invited to send their checks for not more than $25, payable to Charles F. Rand and Arthur S. Dwight. In the event that there is an excess of subscriptions over the amount needed, a pro-rata return to subscribers of $10 or more will be made. The committee headquarters are at Room 1409, 71 Broadway, New York City.

Ohio Survey Active in Scientific and Industrial Investigations

Field Work Is Being Done in Many Counties of the State—Geological Problems Long Unsolved Now Object of Intensive Research

DURING the last year the Geological Survey of Ohio has completed two bulletins which should be of wide interest and value. The first one of these, Bulletin 26, treats of the coal formation clays of Ohio and the second, Bulletin 27, of the geography of Ohio. Both of these bulletins are waiting to be bound.

Because of the great importance of the clay industry in Ohio and the paucity of information concerning the raw materials, the bulletin on the clays should be of real service. It covers the distribution, thickness, and field relations of the clay deposits, their composition as shown by chemical analysis and microscopic examination, and their burning properties. It will make a volume of about 600 pages. The work was done by the Geological Survey of Ohio in co-operation with the U. S. Bureau of Mines. Wilber Stout had charge of the geological investigation, R. T. Stull made the burning tests, D. J. Demorest the chemical analyses, and W. J. McCaughey the microscopic examinations.

Bulletin 27 To Be Geographic Textbook

In preparing Bulletin 27, on the geography of Ohio, the author, Dr. Roderick Peattie, of the Ohio State University, had in mind the teachers in the public schools, but the book will be helpful as well to all those who seek information on the state. It contains about 135 pages and is well illustrated.

Quite different from these bulletins will be one by Prof. C. W. Foulk, of the Ohio State University, on possibilities of the waters of Ohio for industrial purposes. The manuscript for this work is ready for the printer.

The Ohio Survey plans to issue geological reports on several counties, and the manuscript for one of these will soon be ready for the printer. This is on the geology of Columbiana County and is being prepared by Wilber Stout and R. E. Lamborn. The county has large resources of coal and clay and also is a source of pulp stone, and a producer of oil and gas.

Field work is now in progress for two other county reports. Wilber Stout is now working in Vinton County, in the southeast quarter of the state, where there are important coal, clay, oil, and gas deposits as well as iron ores which were mined for many years in the days of the old charcoal furnaces. It is expected also that this investigation will clear up the confusion in the stratigraphy of certain beds in this district.

The other report will cover Jefferson County, in the extreme eastern part of Ohio, which county has still larger resources. Moreover, there is some uncertainty there also in some stratigraphic assignments, notably that of the Steubenville shaft coal. It is hoped that R. E. Lamborn, who has charge of the work, will settle for all time the doubtful points.

Identity of Monroe Limestone Sought

Doubts as to the accuracy of placing the Monroe limestone in the geological column of Ohio have led the Ohio Survey to take up this problem. This formation, which was formerly called Lower Helderberg, has long been classed with the Silurian, but field studies to the north and especially in Canada have shown that it contains faunas that belong in the Devonian. For several field seasons Prof. J. E. Carman, of the Ohio State University, has been giving his time to this problem, and as the rocks extend entirely across the state the task will be a large one.

Although much of the coal outcrops of Ohio have been mapped on topographic sheets, the Upper Freeport or No. 7 coal bed has not been thus mapped except in certain counties. As this bed is one of the state's large sources of fuel, and as it marks the junction of the Conemaugh and Allegheny formations, it is an important horizon. Work to complete this mapping was started in June of this year by Prof. C. F. Moses, of Muskingum College.

The Chrome Reserves of the United States

Report of Subcommittee of Committee on Foreign and Domestic Mining Policy of Mining and Metallurgical Society of America

A SERIOUS attempt has been made to estimate in round numbers the chromium reserves of the United States. This estimate is made by Albert Burch and E. F. Burchard, constituting the chrome subcommittee of the Committee on Foreign and Domestic Mining Policy of the Mining and Metallurgical Society of America, and just published by the society.

The report says: "During the late World War the chief sources of domestic supply were in the Pacific Coast states of California and Oregon, supplemented by an almost negligible production from Montana, Wyoming, and the Appalachian Mountain region; but during the last years of the war important deposits were discovered and partly developed near the coast in Alaska and in Montana. The Montana deposits are said to be not only lower in grade than most of the ores in the Pacific Coast states, but also not capable of being raised to a high grade by concentration, because of the low chromic oxide content of the mineral itself.

"As the deposits of chrome ore are notoriously erratic in size and form, it is not possible to estimate accurately the tonnage of any given deposit, even when fairly well developed, and we have, therefore, used the terms 'probable' and 'possible' rather than 'positive,' 'probable' and 'possible.' We have also endeavored to classify the tonnage as to grade upon the basis of what has already been produced from the various districts, and, as available transportation facilities would have an important bearing upon the quick production of chrome in the event of war, we have also divided the reserves into two classes—viz., 'readily accessible' and 'difficultly accessible,' generally using the arbitrary figure of twenty miles from railroad lines as the dividing point.

Total U. S. Available Supply Less Than 1918 Shipments and Imports

"We have in the United States readily accessible probable and possible ore of all grades amounting to 124,000 tons, which is much less than the combined shipments and imports of 182,572 tons of all grades for the year 1918. It is our belief, however, that a considerable part of the ore shipped and imported in 1918 was added to stocks on hand, and as six to nine months' stock is always carried by consumers, the readily accessible ore would seem to be ample for one year's supplies.

"The principal European countries are really more dependent upon overseas supplies of this important war mineral than the United States, and it might be added that the chance for discovering new bodies of ore in Europe is quite remote.

"On the other hand, some of the non-European countries that we now classify as having a relatively small amount remaining in accessible deposits are known to have large quantities that will probably some day be exploited. This is notably true of Turkey in Asia and is probably true of Brazil."

The total chrome-ore reserves of the United States, including "probable," and "possible," "readily accessible" and "difficultly accessible" are thus estimated: Over 40 per cent, 276,000 tons; 30 to 40 per cent 932,000 tons, with a grand total of 1,208,000 tons. Of this grand total, 1,084,000 tons is "difficultly accessible"—that is, so situated as to be remote from good transportation facilities.

Summing up, the committee, in addition, says:

"The United States has apparently ore reserves in explored territory amounting to about twelve years' normal supply, and very likely these reserves will in time be materially increased as a result of further exploration. The question then arises as to why we are now drawing our supplies from foreign lands instead of using our own. The answer is contained in the two words grade and price. The consumers are unanimous in their statements that the ores of Rhodesia and New Caledonia are much better than most of the United States ores, and so long as most of the consumption is within a few hundred miles of the Atlantic seaboard, ore from Alaska and the mountains of the West cannot compete in price with that imported from abroad."

MEN YOU SHOULD KNOW ABOUT

D. C. Jackling left New York for the West on Nov. 13.

R. H. Channing, Jr., of San Francisco, recently left for New York.

E. W. Engelmann has recently been appointed superintendent of the Magna mill of the Utah Copper Co.

Amor Frederick Keene has opened offices at 42 Broadway, New York City, as consulting mining engineer.

John W. Sherwin, general manager of the West End Mining Co., has returned from a short trip to Mexico.

E. H. Westlake and **F. M. Loper,** both of New York, representing Kerr Lake interests, have been elected directors of the Goldale Mines, Ltd., of Porcupine.

H. A. Eye, manager of the Hayden smelter, returned last week from a visit to the A. S. & R. head office in New York.

D. D. Moffatt, assistant general manager of the Utah Copper Co., is on a visit to the Mesabi Iron Co. at Babbitt, Minn.

Carlos Hieber is building a 75-ton cyanide plant for Matt. W. Alderson at the High Up mine, Virginia City, Mont.

David Johnston, of Toronto, is examining properties in the Kitsumgalum Lake district of British Columbia in the interest of Toronto capitalists.

Frank Merrillis, formerly with the Shasta Zinc & Copper Co., has joined the staff of the construction department of the Nevada Consolidated at McGill.

Ralph C. Nowland, of the staff of D. C. Jackling, has returned to San Francisco from a month's inspection trip at the Utah Copper mine, Bingham Canyon, Utah.

Dr. B. R. Mackay has been appointed geologist on the Canadian Geological Survey to work in collaboration with **Dr. D. B. Dowling** in investigating coal deposits.

F. E. Calkins has just completed an examination of the Henrietta and Butternut mines of the Huron Copper Mining Co., a reorganization of the old Big Lodge Copper Co.

Hugh Rose, manager of Mexican and United States operations for the Consolidated Gold Fields of South Africa, Ltd., has left the Comstock district and is en route to Mexico via San Francisco.

George A. Rupp, of Ironwood, Mich., has joined the exploratory staff of the Michigan Iron, Land & Lumber Co. He has in recent years done considerable drilling on Longyear lands on the Gogebic and Menominee ranges.

Dr. W. L. Goodwin, former dean of the faculty of science, Queen's University, Kingston, Ont., will continue throughout the winter to hold classes for mining prospectors in northern Ontario.

Major Julius Cohen, engineer of the Montreal-Rouyn Mines, Ltd., has returned to Montreal from an examination of the company's property, and reports the discovery of a brecciated zone heavily mineralized.

A. C. Oberg, of Duluth, consulting mining engineer for the State Securities Commission of Minnesota, has been examining mining prospects in the San Dimas district, State of Durango, Mexico, during the last six weeks.

H. C. Smith has left Hayden, Ariz., to become assistant general manager of the Mesabi Iron Co., at Babbitt, Minn. **Walter Garms** is acting superintendent of the Ray Consolidated concentrator at Hayden in Mr. Smith's absence.

G. V. Colchester, who was mining geologist to the Sudan Government in 1922 on special work, has recently completed a professional trek of 3,000 miles, mainly in Darfur, for the Anglo-French Boundary Commission. Mr. Colchester is now at Khartoum.

G. V. Colchester

William D. Cooper, engineer in charge of the properties of the Rouyn Gold Mines, is in Montreal in connection with proposed development work which involves an expenditure of $25,000 in diamond drilling.

C. A. Shepherd, of the Canadian-United States Oil & Refining Co., of Texas, and **J. P. Dempsey,** of Tulsa, Okla., are investigating the new oil field in Romney Township, Kent County, Ontario.

Emil A. Kronquist, of Ironwood, Mich., formerly geologist with M. A. Hanna & Co., is now doing similar work for the Michigan Iron, Land & Lumber Co. (Ford Motor Co.) in the district between Crystal Falls and Michigamme, Mich.

General John C. Greenway, of Bisbee, Ariz., and Mrs. Robert Monroe Ferguson, of Tyrone, N. M., were married at Santa Barbara on Nov. 4 at the home of the bride's uncle, Franklin W. M. Cutcheon, an attorney of New York.

H. A. Nelson, general superintendent, and **Mr. Charles,** superintendent of the mechanical department, of the New Cornelia Copper Co., are visiting the Globe-Miami district for the purpose of studying flotation methods in the concentrators of that district.

Stanly A. Easton, of Kellogg, Idaho, general manager of the Bunker Hill & Sullivan Mining & Concentrating Co., is in New York to attend a meeting of the committee authorized by the Reno conference to work out plans for the organization of a silver export association.

T. A. Rickard, G. J. Young, and **A. W. Allen** are now at the new address of the Pacific Coast office of *Engineering and Mining Journal-Press,* which moved on Nov. 1, 1923, from the Rialto Building to 833 Mission St., San Francisco.

Howland Bancroft has resigned from the Sinclair Consolidated Oil Corporation and will spend the winter in Denver. For the last three years Mr. Bancroft has resided in Panama City, Republic of Panama, where he was vice-president and managing director of the Sinclair Panama Oil Corporation.

T. E. Swigert, the superintendent of the Bureau of Mines petroleum experiment station at Bartlesville, Okla., has been granted leave of absence to engage in geological investigations in Punjab for the Attock Oil Co., Ltd. He will be away from his post for several months.

Gordon Campbell, president of the Calumet & Arizona Copper Co., of Bisbee, Ariz.; **George A. Newett, Captain Tom Hoatson, Thomas Cole,** and **Dr. Charles Briggs,** son of Charles Briggs, the first president of the company, have been visiting the mines at Bisbee and other mining districts of Arizona in which they are interested.

Dr. George Otis Smith, director of the U. S. Geological Survey, will address the Academy of Political Science of New York on Nov. 20. He will discuss the work of the Harding Coal Commission. **F. G. Tryon,** who was the statistical adviser to the Coal Commission, will speak on certain facts developed by the commission's work.

Hugh F. Marriot, past president of the Institute of Mining and Metallurgy, stayed for a few days at Vancouver on his way to England from Australia, where he represented the British Government at the Pan-Pacific Science Congress. At Vancouver Mr. Marriot delivered an address before the Canadian Club on "The Development of the Empire With Reference to Mining."

Jesse F. McDonald, manager of the Down Town Mines Co., at Leadville, and former Governor of Colorado, has been selected by Colorado silver producers as their representative on the board of directors of the American Silver Producers' Association, the organization of which was considered at the Reno meeting, called by the Senate Commission of Gold and Silver Inquiry. **Fred Carroll,** of Ouray, manager of the Atlas Mining & Milling Co., has been selected to act on the organization committee of the Silver Export Association, and left for New York on Nov. 11 to attend a meeting of the committee.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary of the Week

THE copper-mining companies of Arizona are making every effort to avoid curtailment of production. Construction projects, involving $10,000,000, now under way, are being pushed to completion. This indicates confidence in the future.

The Granby Consolidated has suspended operations at the Copper Mountain mine and the Allenby concentrator, in British Columbia.

The Consolidated Gold Fields of South Africa has exercised its option on the Hale & Norcross and the Chollar & Potosi properties, on the Comstock lode. Consolidation with the United Comstock is still in the air.

The California Rand Silver, Inc., has agreed to arbitrate its dispute regarding the ownership of the orebodies in the Coyote claim.

A landslide has shut down the power plant and therefore the smelter of the Granby Consolidated Co. at Anyox, B. C., for a breif period.

The situation in the Portland Canal district, in British Columbia, is described as encouraging by the resident engineer of the province.

Europe is substituting aluminum for copper as a consequence of its inability to finance purchases of the latter metal.

Reconstruction of the Hecla mine plant, in the Coeur d'Alene district of Idaho, progresses rapidly. Production to be resumed about Jan. 1.

The United Verde Extension will probably succeed in having established a $6 rail rate on copper bullion from its smelter to San Pedro.

Raise 7,000 Gal. Per Minute to Unwater Mine

Quapaw Corporation Uses Large Pumps in Picher, Okla., Operations—Problem Has Stumped Others

Unexpected success has been achieved by the Quapaw Mining Corporation, controlled by C. M. Schwab, in unwatering the section adjacent to Quapaw, Okla., in the Picher district. Draining has been completed to a depth of 200 ft. at the Imperial shaft after seventy days of work, during a part of which time water was taken out at the rate of more than 7,000 gal. per minute. At present, however, water is being kept down to the 200 level by pumping only 4,000 gal. per minute. A total of 500,000,000 gal. of water was taken out during the seventy days of operation.

A 10-in. Layne & Bowler pump is in use at the Imperial shaft, with two 6-in. centrifugal pumps. The company also is continuing its pumping at the Brinson-Kirtley shaft, some distance to the east, where a 6-in. centrifugal pump is being used. A new shaft is being sunk a short distance from the Imperial shaft, which will house a 2,500-gal. Cameron pump, and another pump of the same capacity will be installed at the Muskogee shaft, to the north. It is believed these two pumps will be amply able to keep the water at its present level.

The Imperial section has always been considered the hardest "water hole" in the field, and more than $300,000 had been expended by other companies in an unsuccessful attempt at draining before the Quapaw corporation began work. Some engineers estimated the draining would cost probably $350,000, but the cost to date has been much below that figure.

California Rand Silver, Inc., Avoids Litigation Over Ore

The differences existing between the California Rand Silver, Inc., and the Randsburg Silver Mining Co., owning adjoining claims at Randsburg, Calif., have been settled in the following particulars: the Randsburg Silver Mining Co. has quitclaimed all interest claimed in Uranium No. 7 and Uranium No. 10 claims belonging to the California Rand Silver, and the latter has in turn quitclaimed all interest in the ground north of its Uranium group which was located over a year ago. Each company has dismissed its suit against the other, and the questions of the ownership of the ore within the Coyote claim and of conflicting claims in the Silver Reef group are to be submitted to arbitration.

A new development is the discovery of a promising vein of gold ore on the eleventh level in the 1104 North drift. This discovery was made on Oct. 18 and the shoot as far as is now uncovered is 11 ft. in width. Values run from $20 to $30 in gold, with a small amount of silver.

Granby Suspends Work at Copper Mountain

Mine and Mill Ready to Start When Copper Market Looks Up—Wage-Scale Cut at Anyox

The Granby Consolidated Mining, Smelting & Power Co. will completely suspend operations at the Allenby Copper Corporation's mine and mill until there is a marked improvement in the condition of the copper situation. The men who were transferred from Anyox to Copper Mountain and Allenby will be given their old positions at Anyox, where, however, a wage reduction of approximately 50c. per shift in all classes of labor went into effect on Nov. 1.

When the Granby company purchased a controlling interest in the Allenby company the price of copper was standing at 17c. per pound, and arrangements were made for reopening the mine and running the mill at its capacity of 2,000 tons daily and shipping the concentrate to the Trail smelter for treatment. It is understood that everything is in readiness for restarting operations, both at the Allenby company's mine and mill and at the Trail smelter, and that the companies now await only an improvement in the copper market.

It is understood, further, that the copper situation will not affect the Consolidated Mining & Smelting Co.'s activities at Rossland, where the output is essentially a gold ore, copper being a byproduct.

Copper-Mining Companies in Arizona Hope to Avoid Curtailment

No Suspensions Yet as Result of Poor Metal Market—Construction Projects Involving $10,000,000 Continue Steadily—Scale of Work Increases at Morenci

COPPER-MINING OPERATIONS in Arizona have not been curtailed, thus far, by the low market for the metal. The Iron Cap Copper Co., operating at Globe, Ariz., has dismissed fifteen men from its payroll; the two shifts have been consolidated into one. These are the first men to be laid off by any company operating in the Globe-Miami district; yet this does not represent a curtailment of operations, but is an attempt to secure more economical production by putting all the force on day shift.

The Iron Cap was the first property in the district to resume operations after the suspension of copper mining during 1921. High-grade ore with a new and efficient mill enabled this mine to produce cheaply and has made possible disbursements at times when only the "low-cost producers" were able to show a profit. The Arizona Commercial Mining Co., whose property adjoins the Iron Cap, has been operating only one shift throughout the year. No men have been laid off at this property, and it was announced by Charles S. Smith, president of both the Arizona Commercial and Old Dominion companies, while on a recent visit to the properties, that no curtailment of operations was contemplated at the present time. The Inspiration Consolidated Copper Co. recently discontinued work on the 850 level where development was being done and transferred the forty-five men effected to other parts of the mine. A resultant rumor that men were being laid off was quickly denied by the management.

There have been no curtailments in the Bisbee district and no men have been dismissed. The Shattuck company has been short of miners, and there is no surplus of experienced men. Charles W. Clark, president of the United Verde Copper Co., while in Jerome recently, stated that there would be no curtailment of the forces at his company's property. Operations at the United Verde Extension and at the Verde Central and other small properties operating in Jerome are continuing. At Morenci the scale of operations has been increasing, and about 200 men have been added to the payroll of the company during the past two months. The Phelps Dodge Corporation, which operates the Morenci mines, has shown no evidence of lessening the huge plans of development that the company has under way at that place, and it is not believed a curtailment is contemplated. The progress of the remodeling of No. 6 concentrator has made possible an increase in output of 2,000 tons per day.

There are 800 or 900 men at work at the mines of the Ray Consolidated Copper Co., at Ray, Ariz., and there has been no decrease in the working force. Though it is likely that curtailment will result if the low market price for the metal should continue a great length of time, it is now said emphatically by almost all large operators in Arizona that no decrease in output is under consideration at the present time. To inspire confidence in the future of the industry, one need only refer to the huge projects of construction, involving many millions of dollars, that are being carried on by Arizona companies, including a new smelter that will produce more than 2,000,000 lb. per month. All this construction work is being rushed to completion.

Zinc-melting room at the Trail plant of the Consolidated Mining & Smelting Co., in British Columbia

October Copper Shipments Up; Also Refinery Output

ESTIMATES published in financial papers show that copper shipments from refineries in October were the second largest of any peace-time month on record, the total being 210,000,000 lb., which compared with a high record of 215,000,000 lb. last March. Of the total shipments last month, 123,000,000 lb. was for domestic consumption, and nearly 87,000,000 lb. was for export. Shipments in September totaled only 160,000,000 lb. Despite heavy shipments last month a total of about 20,000,000 lb. of the metal was added to surplus stocks. This, it is explained was due to the increased activity on the part of refineries last month, which also reported a peace-time record for any month. Refinery output last month was estimated at 230,000,000 lb., or 20,000,000 lb. more than shipments, making surplus stocks in the country at the present time about 275,000,000 lb., or little more than a month's supply at the present rate of sales. Shipments in September totaled 200,000,000 lb. and in August, the previous peace-time record, the total was 202,500,000 lb.

Consolidated Gold Fields Takes Two Comstock Properties

Subsidiary Has Other Options Pending —More Than 4,500,000 Tons of Ore Said To Be Proved

The Comstock Merger Mines Co., a subsidiary of the Consolidated Gold Fields of South Africa, Ltd., closed a deal on Nov. 1 whereby it becomes owner of the Hale & Norcross and Chollar & Potosi mines, on the Comstock Lode, in Nevada. The mines were the property of Paul Hahnewald and Joseph Eppler. Hugh Rose, who is managing director of the English companies' Mexican and United States operations, represented the purchasers. The ground included in these two properties covers 1,800 ft. along the lode, and takes in all holdings of the Hale & Norcross and Chollar & Potosi companies, including the 75-ton mill of the Comstock Leasing Co., which was closed on Sept. 1 to allow more freedom for the Comstock Merger in doing development work.

If the option on the Savage, Gould & Curry, Best & Belcher, Bullion, and Exchequer mines is finally exercised, the Merger company will own that section of the lode between the Consolidated Virginia and the United Comstock, a distance of about 5,000 ft. Nothing is announced regarding the proposed merger of interests with the United Comstock, a subsidiary of the Metals Exploration Co., negotiations for which were started several months ago, but it is known that such a consolidation is still being considered. The amount of ore now blocked out by the Merger in the two mines taken over is not known, but it is said to be in excess of 4,500,000 tons, which was the estimated reserve ore about the first of the year.

The Berry mine and other property in the Flowery district, five miles east of Virginia City, and on which has been developed a large tonnage of low-grade gold ore, has also been purchased by the Merger company, thereby indicating a policy of staying in the district.

Portland Canal Prospects Need Only Capital for Development

George Clothier, Provincial Engineer, Reviews Current Situation—Premier Will Increase Mill Capacity by Building at Camp 4—Dunwell Looks Good

BY ROBERT DUNN

WHEREVER enough capital has been available for development, encouraging results have been obtained in the Portland Canal mining district of British Columbia. George Clothier, resident mining engineer, sums up in these words his impressions of conditions of the mining industry in that part of the province. Passing over the Premier mine, he instances in support of his statement the Dunwell, Indian, Big Missouri, Outsider, and B. C. Silver properties. The only producer yet is the Premier, but Mr. Clothier expects that the Outsider will be shipping to the Anyox plant of the Granby Consolidated Mining & Smelting Co. before the end of the year and that the Dunwell and Indian mines will be added to the list of shippers next year. He forecasts a considerable enlargement of the Premier Mining company's concentrating plant. In this connection, it is reported on good authority that another unit of the company's milling plant will be built at Camp 4, at which point a site now is being cleared. The suggestion is that machinery and material will be taken in over the snow during the winter and that construction will start as soon as practicable next year. The new unit, it is said, will have a capacity of 150 tons a day, thus doubling the plant's capacity to produce concentrates.

As to the outlook in the Bear River Valley section, Mr. Clothier points to the development of the Dunwell. The George group, twenty miles up the Bear River from tidewater, and six miles beyond the terminus of the Portland Canal short line railway, is expected to be developed next year by the Granby company. If the work leads to good results the extension of the railway should follow.

Diamond drilling has been done this season on the Indian, Big Missouri, and B. C. Silver properties, of the Salmon River Valley. On the Big Missouri, under option to Messrs. Trites & Wood, this work has been suspended temporarily. Much open-cutting has been in progress on the Hercules group, which adjoins the Big Missouri on the north.

In the Alice Arm section Mr. Clothier finds mining progress handicapped through the inactivity of the Dolly Varden mine and railway. With the reopening of work on this property there is no doubt, in his opinion, that the industry generally will improve. There are many surface showings that may become mines. The Homestake Mining & Development Co. has been doing good work on the Homestake group, situated at the head of the Kitsault River about 8 miles beyond the Dolly Varden. The installation of a compressor will permit the continuance of work after snow flies.

Mr. Clothier speaks also of the Kitsumkalum country, referring specially to the Bear group at the head of Kitsumkalum Lake, where a Ross mill has been installed and considerable ore testing has been done. The development of this property is to be continued energetically. Prospecting will be active next spring.

U. S. Supreme Court Will Pass on Utah Employer's Liability

Workman Killed Crossing Railroad Track on Way to Work—Award Made Against Employer

Mining companies, as large employers of labor, are interested in the test of the constitutionality of the Workmen's Compensation Act of Utah in an action that came before the U. S. Supreme Court on Nov. 13. It raises the question as to how far the employer's liability extends. The complaining company is the Cudahy Packing Co. of Nebraska, which is seeking to have set aside an award made for the death of an employee, who was killed en route to work while crossing a railroad in the neighborhood of the company's plant. The award of the public utilities commission was upheld by the state supreme court, to which appeal was made, on the ground that the plant of the packing company is, for its own convenience, situated near the railroad, and in this case so situated that it is necessary for practically all employees to cross the railroad on the way to and from work.

The packing company takes the position that, since the man had not yet reached his place of employment, he was not injured in an accident arising out of and in the course of his employment; and that the commission was without justification in the case. The company argues that the decision is in violation of the Fourteenth Amendment of the Federal Constitution.

The construction placed upon the Utah act is held by the attorneys for the packing company to be broader than any similar statute considered by the U. S. Supreme Court.

Small Concentrator Finished at Colville, Wash.

In the Colville district, in Washington, the Consolidated Silver Mountain Mining Co. has completed a small concentrator and is preparing to raise from the Seelye level 125 ft. to the Terry level before starting the mill. A good tonnage of high-grade lead-silver ore has been blocked out.

Landslide Shuts Down Granby Smelter Temporarily

HEAVY RAIN at Anyox caused a landslide on Nov. 3, which carried away about 200 ft. of the penstock leading to the power house at the Granby company's smelter, and necessitating the closing of the plant. New equipment has been ordered to replace that which was destroyed, but it is expected that it will be a week or ten days before this will arrive and be put in place, and, in the meantime, the plant will remain closed.

Virginia Manganese Deposits Will Be Worked by Lessees

The Kaylor-Fleming Manganese Co. has closed a lease with the Maryland Mining & Fruit Co. on the Bonnetts Hill property, at Zepp, Shenandoah County, Va. It will mine high-grade chemical manganese ore and expects to be ready to ship in the next thirty days. Machinery will be installed for the treatment of ores from the dumps. Mining in this district was carried on as early as 1834, but on a small scale. Alexander Fleming, proprietor of the Uniontown Testing Laboratory, at Uniontown, Pa., will be in charge of operations.

Copper Mines Pay Large Tax in Gila County, Ariz.

Following are the taxes paid by the copper mining companies in Gila County, Ariz., for the first six months of 1923: Miami Copper Co., $233,863; Arizona Commercial Mining Co., $15,961; Ray Consolidated Copper Co., $38,050; International Smelting Co., $58,388; American Smelting & Refining Co., $12,977; Inspiration Consolidated Copper Co., $362,328; Iron Cap Copper Co., $12,977; Old Dominion Copper Co., $81,546.

Statistics recently published by the government show Arizona to have the greatest wealth per capita of all the states, over $2,000 per person. From the above assessments for one-half year's taxes it can be deduced that the mines are the "wealth."

Quincy Hoisted 100 Tons of "Mass" in October

Quincy, in the Michigan copper district, has just sent another large shipment of mass copper, fully 100 tons, to the smelter, representing the clean-up of mass for the month of October. From 20 to 25 per cent of Quincy's output is mass, both Nos. 2 and 6 shafts being rich in heavy copper; many pieces weight five or six tons when hoisted. Quincy's metal stocks are low, for, in addition to Lake shipments, it has been making frequent rail shipments to near-by points. Production, however, is little better than 50 per cent of the average normal for the property.

California Copper Production 2,000,000 Lb. per Month

California mines are producing about 2,000,000 lb. of copper per month. The Mountain Copper Co.'s Iron Mountain mine was shut down on Nov. 3, 1923, after having been in operation only a short time. The low copper market precluded profitable operations. It may be presumed from this that the U. S. Smelting company will reconsider the resumption of smelting operations at its Mammoth plant. Practically all of the large mines except the Mammoth, but including the Iron Mountain, Shasta Zinc & Copper and the Afterthought properties, are shut down tight for the present.

The Hornet pyrite mine of the Mountain Copper Co. is the only large mine in operation in Shasta County. The Island mine, in Trinity County, is shipping several hundred tons of copper ore per month to Tacoma and is practically the only copper mine producing in the northern belt. Engels and Walker mines, in Plumas County, are producing as usual. Calaveras has not produced any copper, although preliminary operations were well advanced several months ago.

News from Washington

By PAUL WOOTON
Special Correspondent

U. V. X. Will Get $6 Rail Rate on Copper to San Pedro, Calif.

I.C.C. Examiner So Recommends—Commission Will Probably Adopt Report—Destination New York and Orient—Blister Copper Makes Desirable Traffic

THE FREIGHT RATE being charged on copper bullion, in carloads, from Clarkdale, Ariz., to San Pedro and East San Pedro, Calif., is unreasonable, in the opinion of John P. Money, an Interstate Commerce Commission examiner. In a tentative report to the commission, in the case of the United Verde Extension Mining Co. versus the Atchison, Topeka & Santa Fe Ry. Co., Mr. Money recommends that any rate in excess of $6 per ton should be found unreasonable. The indications are that the commission will accept the tentative report of the examiner.

The United Verde company attacked the rate on copper bullion as being unreasonable when compared with the rates applicable on bullion from the Salt Lake district of Utah to San Francisco and Los Angeles. The American Smelting & Refining Co., engaged in the smelting of copper ore in the Salt Lake district, intervened in the case for the purpose of maintaining the present rates covering shipments from that district to Pacific ports.

In the course of his tentative report, Mr. Money says: "Approximately 48,000 tons of copper bullion are produced per annum at Clarkdale, 18,000 tons of which are produced by the United Verde Extension Co. The company estimates that with a reasonable rate it will ship one-third of its output to San Pedro. Substantially the entire output of the complainant's smelter is shipped to New York for refining over the Santa Fe to Galveston and the Mallory Steamship Line beyond.

"Copper bullion in carloads, minimum 50,000 lb., is rated fourth class in the western classification, but it moves from practically all producing points to refining points at commodity rates that bear little if any relationship to the class rates. No commodity rates apply on copper from Clarkdale to San Pedro. The fourth-class rate of $1.50 per 100 lb. is applicable, but no shipments have moved under the class rate. The complainant contends that the rate from Clarkdale to San Pedro should not exceed $4 per ton. The complainant desires to utilize water routes from San Pedro to New York and to other consuming territories, including the Orient. At the hearing, the Santa Fe offered to establish a rate of $9.50 per ton, but the complainant insists that such a rate could not be utilized, particularly on copper bullion destined to New York. The all-rail rate from Clarkdale to New York is $16.50 per ton. The rail and water rate through Galveston was $14.50 per ton at the time of the hearing, Feb. 27, 1923, but effective Aug. 25, 1923, it was reduced to $12.50 per ton, minimum weight 60,000 lb., under which wharfage, unloading, and loading charges at Galveston and New York are absorbed. Transit is authorized at New York, and the bullion may be shipped finally to eastern sheet, rolling, and wire mills at through rates from points of origin.

"The complainant emphasizes that copper bullion is desirable traffic and is sought eagerly by the rail carriers as well as by the water carriers operating through the Panama Canal and from the Gulf ports; that it loads to the maximum carrying capacity of the cars furnished; that it may be and is loaded in any character of equipment that can be locked and sealed; that it moves in large volume throughout the year; that the risk assumed is limited to theft, and that the claims for loss in transit are negligible.

"A shipment of copper from Clarkdale to San Pedro will occupy the car by no means for as long a period as when shipped to Galveston, an element of no little importance during periods of car shortage. In the Phelps Dodge case, the commission prescribed rates on copper bullion to Galveston from Douglas, 1,103 miles, of $9.75; from Globe, 1,209 miles, of $10.25; from Clarkdale, 1,364 miles, of $11.50. Those rates are now $12.50, $12.30 and $13.80, respectively. The respective car-mile earnings under those rates are 45.33c., 40.79c., and 40.47c. The ton-mile earnings range from 10.1 mills to 11.4 mills. A rate of $6 per ton will produce about 10.5 mills per ton, and based on a loading of forty tons, about 42c. per car-mile."

War Mineral Relief Findings

Findings of net losses in war minerals operations have been approved by the Secretary of the Interior as follows: William J. Rose, $561.18; Kester & Priest, $79.05; E. B. Griswold, $218.40; Zabriskie & Fallon, $1,421.89; J. J. Sheahan, $315.30. Disallowances have been approved as follows: Tedoc Mining Co., stimulation not established; Boulder Tungsten Products Co., not within the act; John Wood, Jr., stimulation not established; C. F. Zachary, commercial importance not established; Herbst and Allers, net loss not established; Gossett and Williams Bros., commercial importance not established; Silver Lake Mining Co., stimulation not established; Tungsten Queen Mining Co., stimulation not established; Christian Bros., no additional award.

Europe Substitutes Aluminum for Copper

One of the consequences of the inability of the Germans and the French to finance all of the copper purchases which they would like to make has been large substitution of aluminum, according to the observation of a prominent mining engineer who just has returned to Washington from a visit to Europe. He finds that aluminum is being used in many instances where copper or brass would be much more desirable.

The producers of aluminum in Germany and France are taking full advantage of this opportunity to push their products and to secure as wide substitution of aluminum as possible. This engineer points out that it always has been the policy of the aluminum companies in Germany and France to popularize their metal by selling it at the lowest possible price, even when normal return on the investment had to be sacrificed. This was the policy particularly in connection with the distribution of aluminum utensils. As a result, this type of utensil has been used much more generally in those countries than in the United States, where the policy has been one of maintaining higher levels of prices.

U. S. Employment Service Investigates Mine Labor Conditions

Serious Situation Due to High Turnover and Scarcity of Competent Men—Wages Said to Be Good—Propose Amendment to Contract Labor Law

DESPITE the depression that exists in certain branches of the metal-producing industries, the labor situation is highly unsatisfactory. Were there an important expansion in the mining industry, the capacity of most mines to produce would be limited materially by the shortage and the inefficiency of labor. In an effort to meet this situation, an appeal has been made for federal assistance in the investigation of the problem. The U. S. Employment Service, in co-operation with some of the mining companies, has initiated a study of this situation. One of the measures of relief being studied is the possibility of diverting to the metal mines a reasonable proportion of such immigration as is being admitted to the country. The representations that have been made by employers to the Department of Labor indicate that the situation is so serious that its continuance unchanged may mean the closing of some metal mines.

The turnover of labor is very great. One instance was cited in which eighteen different men were engaged in a single month to keep one face going. The turnover cannot be attributed to the rate of wage, as the figures submitted show the rate to have been approximately the same among those receiving $11 a day as among those receiving the minimum wage. At this particular property, the company boarding house is being run at a loss of 50c. per day per man. There is absolutely no discontent arising from living conditions. The situation at this property is typical, it is contended. With few exceptions, the men will admit that the conditions of their employment are satisfactory.

Absenteeism is fully as great as in pre-Volstead days, but the absenteeism that can be charged to drunkenness is practically negligible. The automobile, some say, is the principal contributing factor to this situation.

Efficiency in underground mining depends to an unusual extent on the retention of the same working force. Knowledge of the ground is obtained only by day to day contact with it. Several days are required before a new man knows the ground sufficiently well to break it efficiently. When faces are compelled to stand idle, the accident risk is greatly increased. The operation of mines with inadequate forces greatly increases running expense and overhead costs.

One of the objects of the present study is to have available new data to submit to the immigration committees during the forthcoming session of Congress. Metal-mine operators are anxious to secure an amendment to the contract labor law that will enable them, under Labor Department permit, to arrange with the individual experienced metal miner abroad for a term of service under pre-arranged conditions, one of which will be the prepayment of traveling expenses to the mining property where he is to serve. It is believed that miners from abroad would be more willing to come here if a job is assured in a specific place and mine.

Many Rare Metals in Samples Sent to Reno

CHEMISTS for the Bureau of Mines stationed at Reno, Nev., are examining specimens of ores submitted from all over the country as possibly containing minerals of which the United States lacks essential supplies. Of many samples recently examined for the rare metals, a few gave positive results for the following elements: molybdenum, uranium, radium, vanadium, tungsten, platinum, titanium, thorium, cerium, rare earths and zirconium.

Bureau of Mines Seeks Uses for Silver in Industry

"Find Use for Metal Instead of Metal for a Need," Says Bain—Secretary Work Assures Aid—Young at Work on Exchange

PLANS have been perfected for close co-operation between the Senate Commission of Gold and Silver Inquiry and the Bureau of Mines. The bureau will attempt the technical side of the effort to be made to expand the use of silver. In a letter to Senator Oddie, Secretary Work of the Interior Department, under which the bureau functions, pledges his full co-operation and the co-operation of the bureau in the attempt to meet the crisis which has overtaken the silver-producing industry.

In connection with the silver work which is being planned, Director Bain points out that very little research has been undertaken on silver or its alloys.

"Metals which first came into use," says Mr. Bain, "became widely used before either facilities, methods, or needs or research were appreciated. Their use consequently was developed on a basis of empiricism only. The metals which were not discovered, or which were not isolated until the world was alive to the importance of research, have had the principal benefits of that sort of endeavor. Examples are aluminum and tungsten. We are only now coming to appreciate that, even with the benefit of chance working through centuries, the probability is that the complete field of usefulness of the older metals has not been explored completely.

"It would seem that research applied to the older metals would be likely to broaden their fields just as it has made fields for new metals. Silver, gold, copper, lead, zinc, and iron have found their principal uses largely because the need existed. The hunt then was made for the metal to fill this need. The reverse practice has come to be applied only recently. Studies now are being made to determine what are the additional things for which copper can be used. Research of the same character is being undertaken on zinc. It now has been suggested that work of this sort be undertaken on silver."

John Parke Young has been given office accommodations at the Department of Commerce and is now engaged in going over that department's files in his analysis of the exchange situation. Post-armistice currency curves covering the Indian rupee and the Shanghai tael are being prepared to supplement those already completed showing daily exchange fluctuations of the currencies of England, France, Norway, Denmark, Spain, Argentina, Germany, Switzerland, Canada, Brazil, Chile, Japan, and China. Other countries will be added to this study until it covers the eighteen nations whose currency fluctuations possess particular significance. When these curves are available, they will make easier a study of the whole subject of exchange.

Steel headframe at the California Rand Silver Mine at Randsburg

News from Mining Districts

By Special Correspondents in the Field

London Letter

Lord Harris About-Faces Again in Rhodesia—F.M.S. Liquidates Tin—MacLaren Likes Plymouth Outlook

BY W. A. DOMAN

London, Nov. 1.—Lord Harris, chairman of Consolidated Gold Fields and Gold Fields Rhodesian Development companies, has been the recipient of much acrid criticism in the past, owing to the fact that some of the companies' investments have proved unsuccessful. At one time the Gold Fields was greatly fascinated by West African banket; this subsequently was turned down. Several properties were taken up in Rhodesia, and the majority of them have turned out to be disappointments. The most profitable has been the Shamva Mines. It is scarcely surprising, therefore, that the question of abandoning Rhodesia has received serious consideration. Whatever his faults, Lord Harris is candid, and he admits to having changed his mind again. This *volte face* is due to the altered fortunes of the Cam & Motor mine. It is not that the Gold Fields Rhodesian has remained inactive. Many propositions have come under investigation, and the conclusion formed was that the reefs did not live in depth. The Cam & Motor, the Globe & Phoenix and the Lonely Reef have disproved the theory, and with a general overrunning of the country by engineers representing the South African finance houses, the Gold Fields Rhodesian has decided upon further tests. The company has available something like £200,000 in cash, and instead of wooing Fortune elsewhere, will stick to its first love. Already, a promising prospect is under consideration. The claims are in the Gwanda district and are known as the Legion. At a depth of 60 ft. from the surface a lode 5 ft. wide is assaying 15 dwt. and the engineer cables that the prospects are promising.

Considerable interest is being taken in the statistical position of tin. Exactly what stocks are in existence no one seems to know definitely. The Federated Malay States is being watched closely. It will be remembered that in order to assist the mining industry during the period of depression, the F. M. S. Government took over a large quantity of the metal at about £200 per ton. As the price is now £207, this stock is being liquidated. The present level enables most companies to work at a handsome profit, and operations are being resumed in all directions. Cornwall is particularly active, and East Pool and Tehidy Minerals are expected to come to the front. The former has extracted such rich ore that it is being bagged. (It is perhaps worth mentioning that with the revival in tin mining, the tin-plate industry in South Wales is in full swing.) The Pahang Consolidated (Malay), which has paid no dividend on its ordinary capital since the 20 per cent of 1919-20, has just declared an actual of 7 per cent.

There is talk of a reopening of the question of the Urquhart Concession, the way having been paved by the loan granted by English banks for the export of Russian grain. No official news is available.

Dr. Malcolm MacLaren, on behalf of Bewick, Moreing & Co., has examined the Plymouth Consolidated Gold Mine. Work was stopped recently owing to poor developments. Dr. MacLaren now cables that he considers the prospects favorable for the downward continuation of good ore, and also for further discovery of the shoot in the intermediate levels to the north. He also says there are good indications at the 1,400 level.

Johannesburg Letter

Twelve Companies Make Good Profit—Claim Bought for £5 brings £12,000

BY JOHN WATSON

Johannesburg, Oct. 9—The following figures, for September, show results from the twelve gold mines earning highest profit.

	Tons Crushed	Value or Revenue, £	Working Costs per Ton s.	d.	Estimated Profit, £
Government Areas	145,500	279,918	16	11.3	157,721
New Modder	108,000	228,704	17	0.0	136,913
Crown Mines	215,000	301,409	18	7.5	101,176
Modder B	66,000	138,067	19	1.0	75,082
Modder Deep	42,500	102,812	16	9.0	67,215
City Deep	96,500	174,778	22	9.2	64,922
Van Ryn Deep	61,000	120,227	19	4.5	62,050
Springs	52,500	107,220	23	4.3	51,628
Brakpan	68,500	117,463	21	6.4	50,093
Geduld	66,500	105,735	18	9.0	43,397
Randfontein Central	186,500	219,146	19	4.0	40,140
Robinson Deep	72,600	.....	17	8.9	39,415

Following on the discovery of platinum in the Northern Transvaal, it was unanimously resolved, at a representative meeting of Waterberg farmers held at Nylstroom, last week, to protest against the inclusion of platinum as a precious metal under the Gold Law. A deputation was appointed to meet the Minister of Mines to discuss this question.

The Redwing claims in the Filabusi district, Rhodesia, have been sold to a London house for £12,000. It is said that a prospector found a few pieces of "float" quartz on the surface, there, and sold his find for £5 to two "practical" men who did 20 ft. of trenching and located a virgin reef.

In the new Government of Southern Rhodesia, inaugurated a week ago, H. U. Moffatt, who represents the Victoria district, is the new Minister of Mines and Public Works. The new minister is general manager of the Bechuanaland Exploration Co., Ltd., and a director of the Rhodesia Broken Hill Co., owner of the great lead and zinc mines.

To investigate the platinum discovery in the Waterberg district of the Transvaal, a company called Transvaal Platinum, Ltd., has been formed, with a capital of £15,321 5s. in 61,285 shares of 5s. each. These shares are selling in Johannesburg at £5 10s. Dr. Mellor, consulting geologist to the Central Mining & Investment Corporation, has reported favorably upon farms belonging to the Transvaal Consolidated Land & Exploration Co., and the directors have acquired options over other farms with possibilities. On several of them prospecting operations are being energetically prosecuted. The mineral rights of two farms have been ceded to Transvaal Platinum for 12,000 fully paid shares, and a further 4,000 shares have been subscribed for at £1 each. There is a boom in platinum shares in Johannesburg.

CALIFORNIA

Grass Valley Booms Mildly

Grass Valley is experiencing a fair-sized boom. No discoveries of moment have been publicly announced, and just at present the principal new efforts appear to be concentrated in preparations for underground exploration. The Empire is operating 80 stamps as usual; the North Star is developing and operating about 30 stamps; the Idaho-Maryland and Normandie are prospecting; the Norambago is starting up; the Alcade has a small shoot of high-grade ore, the Osceola, at Rough and Ready, is working, as well as other small properties. The outcome of present efforts will be looked to with interest, as the producing area of the district will be increased if success attends the efforts of the new companies in their exploration work.

Bullard's Bar Dam Wants 3c. Per Yard

The Bullard's Bar dam will be completed during December. It is stated that storage capacity will be offered hydraulic mines at 3c. per cu. yd. The expense for securing water for mining added to this amount will not leave much margin, but hopes are entertained that some hydraulic mining will result on the watershed of the North Yuba River.

Dredge Will Be Dismantled

The Shasta Dredging Co. is scrapping its dredge on the middle fork of Cottonwood Creek, in Shasta County, as dredging ground bonded near Minersville, Trinity County, and on which it was hoped to place the dredge, proved to be too low grade to work profitably.

NEVADA

North Star Suspends Operations at Tonopah

The North Star Tunnel & Development Co. has closed its Tonopah property and is starting operation on the newly acquired Gold Mound mine, four miles west of Grass Valley, Calif., and Tonopah officials of the company are moving to Grass Valley. The North Star is one of the old mines of the Tonopah district and has produced a large tonnage of ore of good grade. The orebodies were scattered and not very large, and costs for development were high so that it has been found necessary to assess the stockholders on various occasions, to finance operations. Machinery will not be moved, as the directors announced that operations will likely be resumed should the price of silver advance to a point that will make profitable operations possible.

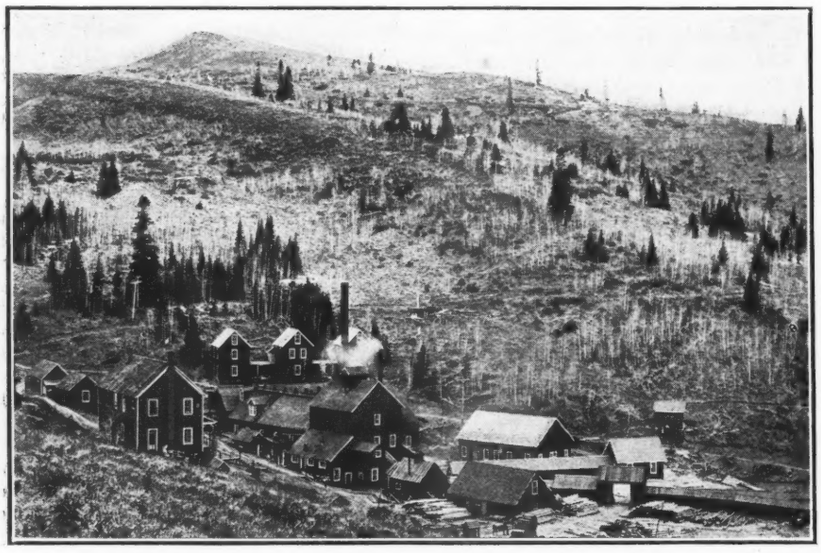
Simon Silver-Lead Would Levy Assessment

The Simon Silver-Lead Mines Co. is again in trouble and has found it necessary to raise money to develop a supply of water and to finance certain operations. A stockholders' meeting is called for Nov. 12 in Mina. The plan to be considered is to reorganize the company on a assessable basis and assess stockholders 1c. per share to start with, the new company to be capitalized for 3,000,000 shares, par value $1. It is thought that a plentiful supply of water can be developed by sinking the new shaft about 200 ft. deeper, and this work will be considered. The mill is operating three shifts, treating over 200 tons of ore per day, so that this assessment proposal comes as a shock to many of the stockholders who had believed that as soon as production was resumed operations would be conducted at a good profit.

UTAH

Silver King Consolidated Assesses for Development Work

The Silver King Consolidated Mining Co., operating at Park City, has levied an assessment of 10c. a share, which it proposed to use in carrying on development work. Search for oreshoots has been continued, and a long tunnel has been driven to develop the Thaynes Canyon section and to connect with the California-Comstock ground later acquired. In making the assessment, the company states that it has undertaken development outside the faulted zone and in ground into which the oreshoots of its neighbor the Silver King Coalition might be expected to continue. Three months ago a drift was started, and this has been driven about 500 ft. Ore is also expected between the tunnel level and the Comstock shaft.



Surface buildings of the Silver King Consolidated Mining Co. at Park City, Utah

Eureka Ore Shipments Increase

Shipments from Bingham for the week ended Nov. 3 amounted to 4,279 cars. Shippers were: Utah Copper, 4,067 cars; Utah Consolidated, 141; United States Mining, 47; Utah-Apex, 12; Bingham Mines, 10; Montana-Bingham, 2.

Park City shipped 2,030 tons during the week, compared with 2,132 tons the week preceding. Silver King Coalition shipped 1,035 tons; Park City Mining & Smelting, 818; Park-Utah, 177.

Eureka shipped 184 cars, compared with 156 cars the week preceding: Chief Consolidated, 75 cars; Tintic Standard, 50; Dragon, 16; Iron Blossom, 12; Eagle & Blue Bell, 8; Colorado, 8; Mammoth, 8; Victoria, 4; Plutus, 1; American Star, 1; Bullion Beck, 1.

Knight Mines, at Eureka, Busy

The ore opened recently at the Iron Blossom mine, at Eureka, on the 400 level of the No. 1 shaft, by lessees, is holding out well. The find is 100 ft. to the east of the ore channel so productive in the past, and its development is being watched with interest. The Dragon, Colorado, and Tintic Drain Tunnel—like the Iron Blossom, controlled by the Knight interests—are being actively operated. The Dragon is producing a good tonnage of fluxing iron ore and carrying on development work at the same time. The Black Dragon shaft has been sunk 130 ft. below the tunnel level, and drifting for ore will be started. The Colorado is making regular shipments both from the mine and from the dump. The ore contains lead, silver, and copper.

Ohio Copper Adds to Leaching Equipment

The installation of equipment for pumping of 1,500 gal. per minute for leaching-in-place operations by the Ohio Copper Co. at Bingham has been completed. The entire equipment has been modernized. Electric lights have been put in on the tunnel level, to facilitate the work around the launders. Hoist house, pumping station, and lower levels are connected by telephone.

It is planned to install a motor to pull the cars to the west drift, where they will be handled over the Bingham Central R.R., which is the property of the Ohio Copper. The operation of pumps will be automatic, and will be controlled by one man. A relay pumping system is used. There are six Allis-Chalmers, electrically driven single-stage centrifugal pumps for use in lifting the water to the surface. Each of these is driven by a 200-hp. motor. Approximately 6,000 ft. of 10-in. redwood, copper-wired pipe has been laid to carry the water from the Mascotte tunnel level, where it is collected, and up the Ohio Copper shaft, a distance of 1,400 ft., to the surface, where it is distributed over the caved areas in troughs.

NEW MEXICO

Samuel Newhouse Will Drill Bonded Property

It appears that the taking over of the Lead Valley and Waterloo ground, owned by Dr. S. S. Warren, in the Tres Hermanas Mountains, 11 miles north of Columbus, was in behalf of Samuel Newhouse, of Salt Lake City. The Mahoney lead property, lying to the west, and some intermediate ground was included. The first payment, due Jan. 1, 1924, has been secured by a sixty-day note. Extensive core drilling will be started at once.

Bonney May Ship Siliceous Dumps

During the last fifteen months, the Bonney mine, at Lordsburg, N. M., has shipped 1,941.60 tons of ore. This produced 1,237.70 oz. of gold, 13,620.52 oz. of silver and 319,821 lb. of copper. The net smelter returns were $53,326, an average of $27.45 per ton. Work was conducted in No. 1 shaft only at the 205 and 275 levels. The main ore reserves that are opened to the 500 level by No. 2 and No. 3 shafts have not been dis-

turbed. Owing to the scarcity of siliceous ores of this type and the insistent demand from the smelters for this particular ore, as indicated by the offers of very favorable smelter contracts, it is likely that the large dumps at the mine will soon begin to move. The conditions for doing this are unusually favorable. The ore can be put aboard cars for less than $1 per ton and the freight rate to smelters at either Douglas, Ariz. or El Paso, Tex., is $1 per ton for ore up to $15 per ton value.

IDAHO

Hecla Reconstruction Proceeds Rapidly —Fireproof Construction Throughout

Rapid progress is being made restoring the surface plant of the Hecla Mining Co. at Burke, which was destroyed by fire on July 13. The two main buildings, one to inclose the compressors and hoist, which will be 44 ft. wide by 267 ft. in length, and the other 54 ft. wide by 248 ft. in length, which will house the blacksmith shop, machine shop, and warehouse, are now under roof, which precludes possible delay on account of bad weather. The headframe between these two buildings is being erected. It will be of steel, 134 ft. high from the collar of the shaft to the center of the sheave wheel. The main buildings will have steel frame, concrete walls and floors, and steel truss roofs, with asbestos covering. The buildings will be absolutely fireproof, no combustible material whatever entering into their construction, and the same will be true of all other buildings. All machinery and equipment is either on the ground or in transit and will be in readiness for installation as soon as the buildings are ready to receive it. The Star mine, owned jointly by the Hecla and Bunker Hill & Sullivan companies, will be operated through the Hecla shaft, and for that reason the plant is being restored on a larger scale than would have been necessary for Hecla alone. The day following the fire it was predicted that it would be a year before Hecla was again productive. Now, a little more than three months after the fire, James F. McCarthy, general manager of the Hecla company, says the mine will be productive by Jan. 1—less than six months after the fire.

ARIZONA

Ivanhoe Sinks to 400 Ft.

The Ivanhoe Copper Co. has sunk a shaft near the northern end of its property at Bisbee on the edge of the largest siliceous outcrop; this shaft is now 300 ft. deep. It is being sunk to the 400 level; 500 ft. of drifting has been done on the 200 level.

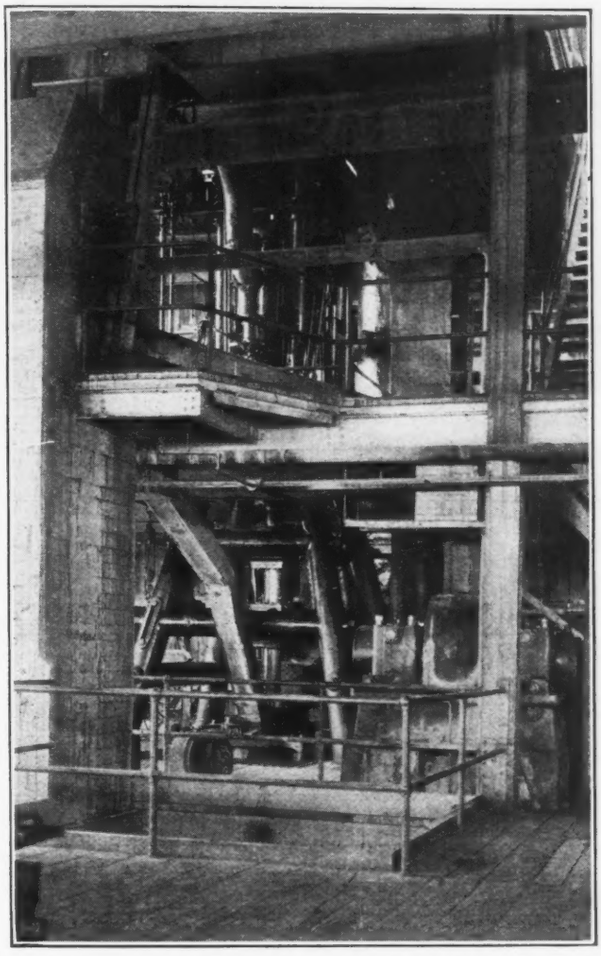
The equipment consists of an 800 cu.ft. motor-driven compressor and a first-motion air hoist, good for 1,000 ft. The property comprises 290 acres, extending from the town of Warren in a southeasterly direction.

The siliceous outcrops are similar to those over the Higgins, Shattuck, Boras, and other orebodies in the Bisbee district.

MICHIGAN

Isle Royale Outputs 800,000 Lb. of Copper Monthly

Isle Royale has considerably increased its underground force during the last two months, and daily rock shipments to the mill have increased accordingly, production now being in excess of 800,000 lb. of refined copper per month. High-grade rock continues to come from Nos. 4 and 5 shafts, and the yield holds close to 27 lb. to the ton. Both shafts are being extensively opened and the lode at depth is strong in copper values. Isle Royale is laying new steel on its railroad from mine to mill, a distance of two miles. No other construction work is under way.



A steam stamp in the Isle Royal mill, in the Michigan copper district

C. & H. and Quincy Cut Copper Stocks

A total of 8,860,000 lb. of copper was shipped by boat out of the Michigan district in October. Of this amount, Calumet & Hecla Consolidated shipped 7,748,000; Copper Range, Mohawk, and Wolverine, 486,000; and Quincy, 626,000. C. & H. and Quincy each made large inroads into their surplus stocks.

JOPLIN-MIAMI DISTRICT

New Shaft on Allie Moore Land Sunk by Underwriters

The Underwriters' Land Co. has begun sinking a new shaft on the Allie Moore land, near Crestline, Kan., located between the McBee mine of the Kanok Metals Co. and the new Crutchfield mill of the Interstate Zinc-Lead Corporation. Drilling has shown a good deposit of shallow lead. The Underwriters company is also drilling on the DeGraff land, in the Crestline field, and the King Tut lease, in the eastern Oklahoma field.

Drills Get Ore on Estes Lease

W. Landrum and associates are beginning a new shaft on the Estes lease, a short distance west of Baxter Springs, Kan. Four drill holes have been put down, showing both lead and zinc coming in at about 185 ft. and continuing to the 200 level. This run of ore will be opened and milled as rapidly as possible. This section of the zinc lead district is the scene of much activity.

THE MARKET REPORT

Daily Prices of Metals

Nov.	Copper, N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
8	12.50@12.625	42.625	43.125	6.75	6.45	6.375
9	12.625@12.75	42.625	43.125	6.75	6.45	6.40
10	12.875	42.50	43.00	6.75	6.45@6.50	6.40
12	13.00	43.00	43.50	6.75@6.90	6.50@6.55	6.40
13	13.125	44.00	44.50	6.85@6.90	6.60	6.40@6.45
14	13.125@13.25	43.375	43.875	6.85@6.95	6.60	6.40@6.45
Av.	12.906	43.021	43.521	6.808	6.517	6.404

*These prices correspond to the following quotations for copper delivered: Nov. 8th, 12.75@12.875c.; 9th, 12.875@13.00c.; 10th, 13.125c.; 12th, 13.25c.; 13th, 13.375c.; 14th, 13.375@13.50c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

Nov.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
8	61 7/8	62 1/2	65 1/4	214 1/2	214 1/4	30	27 1/2	32 1/2	33
9	62 1/2	63 1/8	66	214 1/2	214 1/2	30 3/4	27 3/4	32 7/8	33 1/2
12	62 3/4	63 1/4	68	217	217	31 1/8	28	33 3/8	33 1/2
13	63 1/4	63 3/4	68 1/2	221	221	31 7/8	28 1/4	33 1/2	33 5/8
14	62 3/8	63 1/4	68	220 3/8	220 3/8	31	28	33 3/8	33 1/2

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Nov.	Sterling Exchange "Checks"	Silver		Gold London	Nov.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
8	4 43 1/2	63 1/2	32 1/8	92s 10d	12	4.36 1/4	64 1/8	33 1/16	93s 6d
9	4.40 1/4	63 1/4	32 5/16	93s 4d	13	4.38	64 5/8	33 5/16	94s 1d
10	4.38	63 3/8	32 9/16	.....	14	4.35 1/4	63 5/8	32 15/16	94s 7d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Metal Markets

New York, Nov. 14, 1923

The feature of the non-ferrous metal markets during the week has been the spectacular and steady advance in the price of copper, which has risen about as rapidly as it declined just a few weeks ago. The lead and zinc markets have also improved, so that on the whole the markets have been cheerful ones for the producers. The improvements shown in New York prices have been accompanied by advances in London, despite the drop in sterling exchange. Both copper and lead are in good demand abroad.

Copper

When the history of the copper market shall have been written for the current year the chances are good that the week just ended will go down as one of the best of the period. Practically all copper producers participated in the business, either in domestic or foreign transactions. Heavy tonnages were sold every day to both wire mills and brass manufacturers, price increases being fully justified by the volume of sales made. Last Thursday copper sold for 12¾c. per lb. delivered; today it can be obtained for 13⅜c. with difficulty and most producers are on a 13½c. basis. In other words, the price of copper has risen five-eights of a cent in the short space of six business days. The tendency is still upward.

As soon as it became apparent that the corner in the copper market had been turned, or that prices had reached bottom, consumers made an effort to fill their requirements. Their stocks doubtless had become low, as they had refrained from buying on the decline. This buying wave struck the producers with such suddenness that prices quickly rose. Sales have been made chiefly for delivery during December, January, and February. Some consumers are interested in quotations beyond that month, but only a few producers are willing to quote further ahead. Copper is still selling at abnormally low prices and remains a bargain.

Export business has been fine, with England, France, and Italy buyers. It is rumored in the market that some of the export copper is finding its way into munitions.

Lead

On Nov. 13 the official contract price of the American Smelting & Refining Co. was advanced 10 points to 6.85c. per lb., New York, bringing it back again to the level it was at on Oct. 24. An increased inquiry for lead and the large volume of business previously placed on the books of the company accounts for the advance. Other producers are asking a premium for prompt New York shipment, and 6.95c. has been paid for that class of lead. Sales have also been made at 6.90c. The market in the Middle West has increased to 6.60c., with higher prices occasionally asked, but the metal is still available at the price mentioned. The improved prices have stimulated demand from consumers, and good-sized tonnages have been sold. It has also made the market a little narrower, as at least one producer is holding off watching developments.

The foreign price of lead remains strong, so that it is impracticable to import lead in ores and to sell it here profitably. Until the foreign price declines or the domestic price improves this condition will hold. At present the domestic demand for lead is being met by the domestic production. The lead-covered cable and storage-battery business is splendid. White lead consumption is good and stocks in the hands of jobbers are felt to be low.

Zinc

Prices have improved slightly, carrying them to between 6.40 and 6.45c. per lb. East St. Louis. Sales have been fair to both galvanizers and brass manufacturers. Brass Special was sold

during the week at a premium of $2 per ton over the price of Prime Western. The statistics of the American Zinc Institute for October show an increase in stocks of 2,894 tons. Production was 42,098 tons. Shipments were 39,204; stocks, Oct. 1, 22,893; Oct. 31, 25,787; shipped for export, 6,978. Producers are inclined to look for a renewal of export demand in the near future.

Tin

Prices have jumped around considerably, owing to the irregular and violent movements in sterling exchange. Although the London price has advanced strongly, the drop in exchange has been a compensating factor.

Arrivals of tin in long tons: Nov. 8th, Australia, 20; 9th, Straits, 600; 10th, Straits, 25; 12th, Liverpool, 50; China, 100; Straits, 600; 12th, Liverpool, 100; Straits, 300.

Foreign Exchange

Foreign money in general has declined. On Tuesday, Oct. 13th, francs were 5.575c., lire, 4.36c. and Montreal funds in New York, 1 1/16 per cent discount.

Silver

Stocks strongly held by India, and the weakness of sterling exchange caused a marked advance in price during the last week. On the 14th, however, sales by both China and India reversed the position, and the market reacted sharply.

Mexican Dollars—Nov. 8th, 48⅜; 9th, 48¼; 10th, 48¼; 12th, 48⅞; 13th, 49⅜; 14th, 48½.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—99 per cent grade, 26@27c. per lb.; 98 per cent, 25@26c. London, £115 per long ton.

Antimony — Chinese and Japanese brands 9¼c. W.C.C. brand 9½@10c. Cookson's "C" grade, 12@12½c. Chinese needle antimony, lump, nominal, 6.50c. per lb. Standard powdered needle antimony (200 mesh), 7@8c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, 7.50@8c.

Bismuth—$2.55 per lb. London, 10s.

Cadmium—75c. per lb. London, 2s. 9d.

Cobalt—$3 per lb. for spot.

Iridium—$275@$300 per oz.

Nickel—27@32c. per lb. for 99 per cent virgin metal. London, £125@£130 long ton.

Palladium—$83 per oz.

Platinum—$125 per oz. London, £25.

Quicksilver — $62 per 75-lb. flask. Quiet. San Francisco wires $62. London, £9 5s.

The prices of **Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Selenium, Tellurium, Thallium,** and **Tungsten are unchanged from** prices given Nov. 3.

Metallic Ores

Manganese—Brazilian, 40c. and Caucasian, 42c. per unit. Nominal.

Chrome—$19.25 per ton. Nominal.

Tungsten Ore—High-grade wolframite, $9; high-grade scheelite, $9.50@$10 per unit. Ordinary grades, $8@$8.25.

Iron Ore, Magnetite, Molybdenum, Titanium, Vanadium, and **Zircon Ore** are unchanged from the quotations published Nov. 3.

Zinc and Lead Ore Markets

Joplin, Mo., Nov. 10—Zinc blende, per ton, high, $42.15; basis 60 per cent zinc, premium, $42@$42.50; Prime Western, $41@$41.50; fines and slimes, no sales reported; average settling price, all blende, $40.15; calamine, basis 40 per cent zinc, $26@$28.

Lead, high, $82.70; basis 80 per cent lead, $80@$79; average settling price, all lead ore, $80.95 per ton.

Shipments for the week: Blende, 17,211; calamine, 30; lead, 1,595 tons. Value, all ores the week, $821,110.

The restriction movement reduced the output to around 5,000 tons this week. Sellers are holding so firm that they have caused prices to advance steadily since the end of June, when the basis price had dropped to $34 for premium blende. Half the ore in the bins is sold and some smelters are reported as anxious to contract a large tonnage, but only a limited tonnage of the reserve stock is placed on the market each week.

Platteville, Wis., Nov. 10—Blende, basis 60 per cent zinc, $43 per ton. Lead, basis 80 per cent lead, $80 per ton. Shipments for the week: Blende, 606 tons; lead, 40 tons. Shipments for the year: Blende, 27,751; lead, 690 tons. Shipments for the week to separating plants, 953 tons blende.

Non-Metallic Minerals

Asbestos—Crude No. 1, $350@$450; No. 2, $200@$250; spinning fibers, $100@$125; magnesia and compressed sheet fibers, $60@$90; shingle stock, $50@$65; paper stock, $30@$40; cement stock, $17@$20; floats, $6@$12. **All f.o.b. mines, per short ton, Quebec.**

Graphite—Amorphous grades, $15@$35 per ton, f.o.b. New York. For Ceylon grades see issue of Nov. 3.

Barytes, Bauxite, Beryl, Borax, Chalk, China Clay, Diatomaceous Earth, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gypsum, Limestone, Magnesite, Manjak, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur, Talc and **Tripoli** are unchanged from the Nov. 3 prices.

Mineral Products

Arsenious Oxide (white arsenic)—13@14c. per lb. depending upon delivery.

Copper Sulphate—5@5.10c. per lb., domestic product.

Potassium Sulphate, Sodium Nitrate, and Sodium Sulphate are unchanged from quotations of Nov. 3.

Ferro-Alloys

Ferromanganese — Domestic, **78@82 per cent, generally obtainable at $110** per gross ton, f.o.b. works. **Spiegeleisen,** 19@21 per cent, $42; 16@19 per cent, $41.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium and **Ferrovanadium** are unchanged from the prices published Nov. 3.

Metal Products

Copper—Sheets, 21c. base; wire, 16c.

Lead Sheets—Cut, 10.50c.; full, 10.25c. per lb.

Nickel Silver—18 per cent Grade A sheets, 28c.

Yellow Metal — Dimension sheets, 18.75c.; rods, 15.75c.

Zinc Sheets—Base price, $9.25 per 100 lb., f.o.b. plant.

Refractories

Bauxite Brick, Chrome Brick, Firebrick, Magnesite Brick, Magnesite Cement, Silica Brick and Zirkite are unchanged from the Nov. 3 prices.

The Iron Trade

Pittsburgh, Nov. 13, 1923

The general tone of the steel market, or the feeling in the trade, has undergone further improvement, favorable influences being the well-sustained heavy production and consumption and the maintenance of prices. Fears that there was overproduction of steel in the forepart of the year and that there would be stocks to be liquidated, even with a continuance of heavy consumption, are largely allayed. The outlook is much more promising than it seemed to be a few months ago.

Production of steel ingots in October was at 41,000,000 tons a year, with a decrease from September of only .55 per cent in the daily rate, against monthly decreases averaging 3 per cent in the five months May to September. A falling off in the late weeks of this year would be regarded as simply seasonal. The year's output will be more than one-third greater than the average in the four post-war years preceding.

Prices on the important finished steel products continue to hold well, except for a continuance of the slight shading in black and galvanized sheets, this shading being on prompt shipment only.

Freight car prices have yielded little, and hence there is not much buying. Prospects seem good for heavy general consumption of steel in 1924.

The Steel Corporation's unfilled tonnage decreased 362,925 tons in October, equal to 25 per cent of capacity, which with shipments at about 90 per cent, indicates bookings at 65 per cent, against 58 per cent in September, and the heaviest since last May.

Pig Iron—Bessemer is off 50c. to $3.75@$4 for furnace and $5@$5.50 for basic at $22, all f.o.b. Valley furnaces. The market is dull and weak.

Connellsville Coke—Spot remains at $3.75@$4 for furnace and $5@$5.50 for foundry. Demand is light, with production further curtailed, and there is less coke on track awaiting sale.

COMPANY REPORTS

Shattuck Arizona Copper Co.

Copper; Bisbee, Ariz.

The following is a report of the results of operations of the Shattuck Arizona Copper Co. for the quarter ended Sept. 30, 1923:

Shipments of lead-silver ore, which were discontinued on June 27, were resumed on Sept. 27, as the reduction obtained on treatment charges, together with the rise in the price of lead, allowed the company to begin shipping lead ores at a fair margin of profit. During the quarter only 1,475 dry tons of lead ore was treated at the smelter. The bulk of this ore was in suspense at the end of June. The average price received for the lead contained in these ores was 6.97c. per lb., and the net cost, after credit for gold and silver, was 3.64c. per lb.

Upon discontinuance of the lead shipments in June, efforts were concentrated on copper ore, and by July 11 the shipments of copper were increased to 150 tons per working day, and using care in sorting there was a slight increase in the grade, which was maintained during the quarter.

The total exploration and development during the quarter was 981 ft. as follows: Drifts, intermediates and crosscuts, 648½ ft.; raises, 332½ ft.

The average cost for all development work for the expense at the face was $10.82 per ft. and the average cost of development work per dry ton of copper ore mined was $1.12.

The production for the third quarter was as follows:

	Copper	Lead and Silica
Dry tons mined	11,187.50	.....
Dry tons treated	10,414.87	1,518.916
Pounds metal produced	1,506,038.00	148,333.000
Ounces silver produced	80,324.00	23,117.000
Ounces gold produced	766.62	104.880
Net operating cost per pound	6.45c	3.64c

The net operating cost is for delivered metal after credit for gold and silver byproducts, but before depreciation, depletion, or deferred development expense.

The results in earnings for the third quarter of 1923 were as follows:

Refined copper at 13c. per pound		$195,784.94
Gold and silver byproducts		63,717.77
Lead and silica settlements from smelter		28,023.67
Interest		9,912.73
		$297,439.11
Operating expense, copper	$160,829.41	
Operating expense, lead and silica	23,748.40	
Administration expense and taxes	8,353.77	
		192,931.58
Net income, plus depreciation, depletion and deferred development		$104,507.53

The results on lead and silica are actual settlements, while the copper production value is based on 13c. per lb. for copper metal, 60c. per oz. for silver and $20 per oz. for gold.

The Coniagas Mines, Ltd.

Silver; Cobalt, Ontario

An interim report of the Coniagas Mines, Ltd., covers only eleven months—namely, from Nov. 1, 1922, to Sept. 30, 1923, inclusive, and as some smelter and other returns are not yet to hand, the figures are estimated to some extent.

The Coniagas Mines has operated continuously, mining and developing known veins, stringers and orebodies. The returns for silver marketed during the period have not all been received, but it is estimated that the average price will be approximately 65c. per oz., compared with 70.09c. for the previous fiscal year. The objective of 1,000,000 oz. silver for the twelve months will have been reached.

The concentrating mill operated continuously, except for minor shutdowns, due to failure of power and other exigencies of operation, and treated 127,713.9 tons, with an extraction of 83.26 per cent of silver contained in the ore, The comparative figures for the corresponding period of the previous year show 113,823.3 tons of ore treated, with an extraction of 81.06 per cent.

Newray Mines

The last annual report to the stockholders referred to an option which had been taken by the directors on a majority of the capital stock of the Newray Mines, Ltd., in the Porcupine district. During the present year the mine has been unwatered and work has been carried on vigorously. This work consisted of drifting 606 ft. on the 400 level and upraising to connect this level with a new three-compartment shaft being sunk from the surface. It is the intention to continue sinking this shaft to a depth of 1,000 ft. and carry on exploration at that level.

Surface work has consisted of general repairs to the buildings and equipment, in addition to the erection of a new steel headframe, power house, and power-plant equipment. A transmission line to the South Porcupine substation of the Great Northern Power Co. has also been completed, and the necessary machinery and equipment to carry out the development of the lower levels of this property will have been installed by the end of the current calendar year. To date about $117,000 has been expended on this property.

Ruby Mine

The last annual report gave particulars of the Ruby and adjoining silver claims in the Township of Bucke. An active program of sinking, crosscutting, and drifting upon the Ruby property has been carried on throughout the year, but results to date, though encouraging, would not warrant the company exercising its option on this property. To date, about $53,000 has been expended on this venture.

Beaver, Badger, and Prince Davis

The last annual report stated that negotiations had been completed for leasing the Beaver, Badger and Prince Davis properties, in the southeastern part of Coleman Township. The primary reason for leasing this group of properties was to explore a zone at the lower diabase Keewatin contact. Operations on the upper levels of the Beaver property were begun on Jan. 17, 1923, and are being carried on. The concentrating mill began operating on July 17 last, and has been working continuously since. The unwatering of the old workings, which were connected with adjoining properties, delayed operations on the lower levels, but this has now been completed, and development work is being carried on at the 1,200 level. A crosscut is being driven at this level toward the Prince Davis property, to explore this area. No profit has been derived from these operations. About $116,000 has been expended on these properties to date.

The options taken on properties in the Rouyn and Kowkash districts have not been exercised.

The Coniagas Reduction Co., Ltd.

This company's plant at Thorold, Ontario, has been operated continuously since Feb. 20 last, under an agreement of that date with the Coniagas Alkali & Reduction Co., Ltd., and the Electro Bleaching Gas Co. and Niagara Alkali Co., of Niagara Falls, N. Y. Important improvements in processes have been made, and operations to date are encouraging.

The plant and equipment of the company's various properties have been maintained in an excellent physical condition.

The following is a statement of the quick assets and liabilities of the company as of Sept. 30, 1923. This statement, of course, takes no account of the assets and liabilities of the Coniagas Reduction Co., Ltd., nor of inventories or supplies on hand.

Statement of Quick Assets and Liabilities

Assets

Victory bonds, present market value	$933,343.50	
Accrued interest	20,384.35	
		$953,727.85
Guaranteed investment, Toronto General Trusts Corporation	$300,000.00	
Accrued interest	5,937.50	
		$305,937.50
The Coniagas Reduction Co., Ltd.		249,500.00
Contingent funds		7,373.66
Ore in transit		41,000.00
Accounts receivable		168,210.64
		$1,725,749.65

Liabilities

Sundry accounts payable	$22,772.80
Surplus	1,702,976.85
	$1,725,749.65

California Rand Silver, Inc.

Silver; Randsburg, Calif.

A report of operations of the California Rand Silver, Inc., for the year ending Sept. 1, 1923, states that the outstanding feature of the mining enterprise today is the practical demonstration that the property can be operated profitably even though compelled to accept the world's market quotation for silver from 62c. to 65c. per oz.

The company has been able to pay its regular monthly dividend of 2c. a share, requiring a distribution of $25,600, and has at the same time increased surplus during the months of June, July, and August by, roundly, $135,000.

Success in the face of what may be termed a general stagnation in the silver-producing industry may be attributed largely to the fact that in the prosperous years under the Pittman Act every provision was made as against the lean years to come, to facilitate the handling of a larger daily tonnage and at correspondingly decreased costs, states the report. The original mill, with a capacity of 150 tons, was enlarged during the last year to 200 tons, and then almost immediately another unit was added, giving a capacity of 400 tons. The report continues:

"So long as silver is above 60c. an oz. the mine can be operated at a substantial profit until the orebodies of commercial value are exhausted. Unfortunately, a vast deal of very low-grade ore which, at a dollar an ounce, could have been mined to advantage, must remain in the ground with silver at from 60c. to 65c. an oz. This reduces reserves tremendously for all practical purposes, and stockholders are advised that the life of the mine must necessarily depend upon the discovery of new orebodies.

"For the year there were 16,161 ft. of underground development, this being virtually identical in footage with the preceding year's record. Up to Sept. 1, a total of 44,455 ft., or over 8 miles, of underground development work has been done since the opening of the mine.

"Aside from development work in other shafts, shafts 1 and 2 produced 134,000 tons of rock during the year, segregated as follows:

	Tons
Shipping ore	8,830
Milling ore	80,790
Waste	44,380
Total	134,000

Total of Production

Recapitulation of All Production to Aug. 1, 1923

From ore	Gold, Ounces	Silver, Ounces
Prior to Sept. 1, 1922	10,084.253	4,232,241.73
Sept. 1, 1922-Aug. 1, 1923	1,625.658	923,563.35
From concentrates		
Prior to Sept. 1, 1922	1,176.853	363,695.44
Sept. 1, 1922-Aug. 1, 1923	5,147.982	1,471,451.97
Grady lease	5,429.989	1,487,742.11
Totals	23,464,735	8,478,694.60

Values from ore		
Prior to Sept. 1, 1922	$4,602,650.17	$3,312,908.33
Sept. 1, 1922-Aug. 1, 1923	927,652.88	689,357.14
Values from concentrates		
Prior to Sept. 1, 1922	388,020.99	323,086.75
Sept. 1, 1922-Aug. 1, 1923	1,412,126.87	1,192,587.70
Grady lease	1,599,979.98	1,099,119.70
Totals	$8,930,430.89	$6,617,059.62

The mill has treated 90,363 tons of ore in the 332 days, which is an average of 272.17 tons per day. There were 27½ days lost time, of which 50 per cent was due to delays such as water shortage, ore shortage, or power interruptions. The running time efficiency was 91.72 per cent. The running time tonnage averages 296.75 tons per day.

The average gold heads were $1.93; average gold tails were $0.528; average gold extraction was 72.64 per cent. The average silver heads were $15; average silver tails $1.50; average silver extraction was 90.00 per cent. The total average heads were $16.93; total average tails were $2.02; total average extraction was 88.50 per cent. Recovery per ton was $14.91; total recovery on 90,363 tons, 1,347,312.33; average concentrate value per ton, $307.29; tons of concentrates shipped, 4,595.414; gross value of concentrates shipped, $1,412,126.87; net value of concentrates shipped, $1,192,587.70. Cost of marketing 4,595.414 tons of concentrates was $219,539.17, or $47.77 per ton.

After payment of the dividend of Sept. 4, 1922, the company had on hand a balance of $319,200. Revenues from the smelter for ore and concentrates for the year was $1,881,944.84, to which is to be added some bullion sold, interest earned, and sundry receipts, totaling $17,624.87, making a total revenue of $1,899,569.71.

Principal items of disbursement were: Labor, $517,909.90; materials and supplies, power, development, litigation, insurance, and incidentals, $484,128.54; taxes, $147,268.66.

The company paid in dividends to stockholders, including the September, 1923, dividend, $819,200, and had on hand Sept. 4 a balance of $589,841.28, an increase of $270,641 over the balance at this time last year.

In the four years and two months' operation of the mine there have been distributed dividends as follows: An initial dividend of 7½c. per share, forty-four regular dividends at 2c. per share and eleven extra dividends at 10c. per share, making a total of $2.05½ per share, or $2,630,400.

Gold and Silver Imports and Exports at San Francisco

The statistics indicating the movement of gold and silver into and out of the port of San Francisco during September, 1923, are as follows:

Imports—In Ore and Base Bullion

From	Gold	Silver
Canada	$66,641	$427,977
Nicaragua	53,924	16,395
Mexico	49,065	76,532
Bolivia	3,133	198,421
Peru	101,366	267,609
China	99,067	115
Dutch East Indies	134,467	30,957
Philippine Islands	169.214	3,681
New Zealand	108,413	140
Totals	$785,316	$1,021,827
Coin and other bullion	47,300	24,424
Totals	$832,616	$1,046,251

Exports

Foreign		
China	.....	$1,621,226
Hongkong	.....	188,321
Totals 2,840,613 oz. silver	.....	$1,809,547
Domestic	.....	.....
Mexico	$20,915	
China	.....	$2,291,110
Hongkong	34,200	79,433
Total, 3,719,995 oz. silver	$55,115	$2,368,543

The total exports of refined silver for September, 1923, were 6,560,608 oz. The San Francisco price of silver on the basis of declared value for the month was 63.68c. per oz.

MINING STOCKS

Week Ended November 10, 1923

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	...	...	*58	June 23, Q	$1.50
Alaska-Br. Col.	N. Y. Curb	*75	*57	*57	...	...
Allouez	Boston	...	...	*16	Mar. '19	1.00
Anaconda	New York	38⅛	35	38⅛	Se. 15, Oc. 22, Q	0.75
Arcadian Consol.	Boston	2⅞	1¾	2⅞	...	...
Ariz. Com'l.	Boston	9	8	9	July '23,	0.50
Calaveras	N. Y. Curb	...	...	2¾	...	...
Calumet & Arizona	Boston	45	44	45	Se. 7, Se. 24,	1.00
Cal. & Hecla (New)	Boston	19½	18¼	19½	June '23, Q	10.00
Centennial	Boston	...	...	7	Dec. '18, SA	1.00
Cerro de Pasco	New York	41⅜	39½	41⅞	Oc. 18, No. 1, Q	1.00
Chile Copper	New York	27⅛	26⅛	27⅜	De. 1, De. 29, Q	0.62½
Chino	New York	17½	15⅞	17⅛	Sept. '20, Q	0.37½
Con. Cop. Min. (New)	N. Y. Curb	1½	1 1/16	1½	...	...
Copper Range	Boston	26¼	22¼	26¼	May '23, Q	1.00
Crystal Copper	Boston Curb	66	60	65	...	...
Davis-Daly	Boston	2¾	2½	2¾	Mar. '20, Q	0.25
East Butte	Boston	5⅜	4⅝	4½	Dec. '19, A	0.50
First National	Boston Curb	33	30	33	Feb. '19, SA	0.15
Franklin	Boston	1¼	*90	1¼	...	...
Gadsden Copper	Boston Curb	*40	*36	*36	...	...
Granby Consol.	New York	16	13	16	May '19, Q	1.25
Greene-Cananea	New York	16½	13⅞	16⅛	Nov. '20, Q	0.50
Hancock	Boston	1⅜	1⅜	1⅜	...	...
Howe Sound	N. Y. Curb	2⅞	2¼	2⅝	Oc. 1, Oc. 15	0.05
Inspiration Consol.	New York	28	26½	28	Se. 13, Oc. 1 Q	0.50
Iron Cap	Boston Curb	...	...	3½	May 23, K	0.15
Isle Royale	Boston	20	17½	20	Se. 1, Se. 15,	0.50
Kennecott	New York	34½	32½	34½	Se. 7, Oc. 1,	0.75
Keweenaw	Boston	*75	*75	*75	...	...
Lake Copper	Boston	1½	1½	1½	...	...
Magma Copper	New York	31½	29½	31½	Jan. '19, Q	0.50
Mason Valley	N. Y. Curb	2	1⅞	1⅞	...	...
Mass Consolidated	Boston	1⅜	1	1⅜	Nov. '17, Q	1.00
Miami Copper	New York	22½	21	22¼	No. 1, No. 15, Q	0.50
Michigan	Boston	1	1	...	...	...
Mohawk	Boston	*35	*31½	*35	Se. 22, Oc. 13,	1.00
Mother Lode Coa.	New York	9	8⅛	9	Je. 8, Je. 30, Q	0.50
Nevada Consol.	New York	11	10⅜	11	Sept. '20, Q	0.25
New Cornelia	Boston	*17½	*15½	*17½	Au. 3, Au, 20, Q	0.25
New Dominion	N. Y. Curb	2⅜	2¼	2⅜	...	...
North Butte	Boston	...	...	2	Oct. '18, Q	0.25
Ohio Copper	N. Y. Curb	*94	*86	*90	...	...
Old Dominion	Boston	18	14⅞	18	Dec. '18, Q	1.00
Osceola	Boston	...	...	31½	June '23, Q	1.00
Phelps Dodge	Open Mar.	†150	†140	...	Se. 20, Oc. 2 Q	1.00
Quincy	Boston	23½	19½	23½	Mar. '20, Q	1.00
Ray Consolidated	New York	12⅜	11	12⅛	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	*25	*20	*20	...	...
St. Mary's Min. Ld.	Boston	*32	*29	*31½	No. 9, De. 11, K	1.00
Seneca Copper	New York	7¼	5⅜	7	...	...
Shannon	Boston	*70	*44	*70	Nov. '17, Q	0.25
Shattuck Arizona	New York	6½	5½	5⅞	Jan. '20, Q	0.25
South Lake	Boston	1½	1½	1½	...	...
Superior & Boston	Boston	1½	1 7/16	1⅜	...	...
Tenn. C. & C. cfs.	New York	9⅛	8⅜	9	Se. 29, Oc. 15, Q	0.25
Tuolumne	Boston	*80	*50	*80	May '13,	0.10
United Verde Ex.	N. Y. Curb	28	27	27½	Oc. 5, No. 1, Q	1.00
Utah Consol.	Boston	*80	*70	*70	Sept '18,	0.25
Utah Copper	New York	62⅜	59	62½	Se. 14, Se. 29, Q	1.00
Utah Metal & T.	Boston	*45	*40	*45	Dec. '17,	0.30
Victoria	Boston	¾	¾	¾	...	...
Winona	Boston	*30	*27	*30	...	...
Wolverine	Boston	5	4½	5	...	...
NICKEL-COPPER						
Internat. Nickel	New York	12	10¾	12	Mar.' 19,	0.50
Internat. Nickel pfd.	New York	80	78	80	Oc. 11, No. 1 Q.	1.50
LEAD						
Ahumada	Boston Curb	5½	5½	5½	...	...
Carnegie Lead & Zinc	Pittsburgh	2⅛	1⅞	1⅞	...	...
National Lead	New York	124⅜	121½	123½	No. 22, Dec. 15 Q	1.75
National Lead pfd.	New York	111½	111½	111½	Au. 24, Se. 15 Q	1.75
St. Joseph Lead	New York	20¾	20¼	20¾	Se. 9, Se. 20 Q, X	0.50
ZINC						
Am. Z. L. & S.	New York	8⅛	8⅛	8¾	May '20,	1.00
Am. Z. L. & S. pfd.	New York	30	28½	30	Nov. '20, Q	1.50
Butte C. & Z.	New York	5⅛	5	5⅛	Mar. '23,	0.50
Butte & Superior	New York	16⅛	14	16⅜	Je. 15, Je. 30, Q	0.50
Callahan Zn-Ld.	New York	4¼	4	4¼	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	140½	140	140	Oc 31, No. 10, Q	2.00
United Zinc	N. Y. Curb	...	...	*50	...	...
Yellow Pine	Los Angeles	*70	*70	*70	June '23, Q	0.03
SILVER						
Alvarado	N. Y. Curb	2	2	2	...	...
Batopilas Mining	New York	...	...	⅛	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*26	*24	*25	May '20, K	0.03
Candelaria	N. Y. Curb	*5	*4	*4	...	...
Castle-Trethewey	Toronto	*42	*30½	*42	...	...
Coniagas	Toronto	2.15	2.15	2.15	Oc. 19, No. 1, '23	0.02½
Crown Reserve	Toronto	*59	*57½	*59	Jan. 17,	0.05
Kerr Lake	N. Y. Curb	...	...	2⅝	Oc. 1, Oc. 15, Q	0 12½
La Rose	Toronto	*23	*20	*20	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	*15½	*14	*14½	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	3.07	2.90	2.94	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	5⅞	5¾	5⅞	Se. 3, Oc. 17, Q	0.30
Ontario Silver	New York	...	...	6½	Jan. '19, Q	0.50
Temiskaming	Toronto	*34	*32½	*34	Jan. '20, K	0.04

Stock	Exch.	High	Low	Last		Last Div.
GOLD						
Alaska Gold	New York	¼	¼	¼	...	...
Alaska Juneau	New York	1⅛	1	1	...	...
Boundary Red M.	N. Y. Curb	...	...	*12	...	...
Carson Hill	Boston	4	3	4	...	...
Cresson Consol. G.	N. Y. Curb	3½	3½	3⅝	Se. 30, Oc. 10, Q	0.10
Dome Mines	New York	36⅛	35⅝	36	Oc. 12, No. 1, Q	1.75
Golden Cycle	Colo. Springs	1.10	1.09	1.09	Dec. '22, Q	0.02
Hollinger Consol.	Toronto	11.55	11.35	11.50	No. 15, De. 3,	0.05
Homestake Mining	New York	61¼	60½	60½	No. 20, No. 26 M	0.50
Kirkland Lake	Toronto	*33	*31½	*30½	...	...
Lake Shore	Toronto	3.65	3.55	3.60	No. 1, No. 15 '23 Q	0.02
McIntyre-Porcupine	New York	16⅜	16⅛	16⅛	Au. 1, Se. 1, Q	0.25
Portland	Colo. Springs	*35	*35	*35	Oct. '20, Q	0.01
Teck-Hughes	N. Y. Curb	1¼	1¼	1¼	...	...
Tom Reed	Los Angeles	*51	*44	*44	Dec. '19,	0.02
United Eastern	N. Y. Curb	1 1/16	1⅛	1 1/16	Oc. 8, Oc. 28, Q	0.15
Vipond Cons.	Toronto	*93	*90½	*90½	...	...
Wright-Hargreaves	Toronto	3.40	3.10	3.10	Se. 15, Oc. 1, Q	0.02½
Yukon Gold	N. Y. Curb	*69	*69	*69	June '18,	0.02½
GOLD AND SILVER						
Boston-Mont. Corp.	N. Y. Curb	*23	*16	*17	...	...
Con. Cortez	N. Y. Curb	*49	*48	*49	...	...
Con. Virginia	San Francisco	10½	10½	10½	...	...
Continental Mines	N. Y. Curb	...	...	4⅜	...	...
Dolores Esperanza	N. Y. Curb	*90	*90	*90	Jy. 1, Jy. 10 Q	0.05
Jib Consol.	N. Y. Curb	...	...	*65	...	...
Tonopah Belmont	N. Y. Curb	*62	*59	*62	Apr. '23, Q	0.05
Tonopah Divide	N. Y. Curb	*52	*48	*50	Se. 22, Oc. 10	0.10
Tonopah Extension	N. Y. Curb	1⅞	1⅞	1⅞	Se. 10, Oc. 1	0.05
Tonopah Mining	N. Y. Curb	1⅝	1 1/16	1 1/16	Se. 30, Oc. 1	0.07½
Unity Gold	N. Y. Curb	...	...	3½	...	...
West End Consol.	N. Y. Curb	*72	*68	*68	Mar. '23, Q	0.05
SILVER-LEAD						
Bingham Mines	Boston	17	14½	17	Sept. 19, Q	0.25
Cardiff M. & M.	Salt Lake	*81	*80	*81	Dec. '20,	0.15
Chief Consol.	Boston Curb	3½	3	3¼	Au. 1, '23, Q	0.10
Columbus Rexall	Salt Lake	*23½	*20½	*23½	Aug. '22,	0.03
Consol. M. & S.	Montreal	26	25½	25½	Oct. '20, Q	0.62½
Erupcion	Boston Curb	1⅛	1	1⅛	Se. 15, Oc. 2	0.125
Federal M. & S.	New York	13	8½	12⅞	Jan., '09,	1.50
Federal M. & S. pfd.	New York	47⅞	42	46½	Au. 25, Se. 15,	1.75
Florence Silver	Spokane	*14	*11	*14	Apr. '19, Q, X	0.01
Hecla Mining	N. Y. Curb	8⅛	8⅛	8⅛	Au. 15, Se. 15	0.15½
Iron Blossom Con.	N. Y. Curb	*29	*25	*25	Oct. 25, '23,	0.02
Marsh Mines	N. Y. Curb	*11	*11	*11	June '21, I	0.02½
Park City	Salt Lake	3.30	3.30	3.30	Se. 15, Oc. 1 Q	0.12
Park Utah	N. Y. Curb	....	....	3	Se. 15, Oc. 1 Q	0.15½
Prince Consol.	Salt Lake	...	...	*75	Nov. '17,	0.02
Silversmith	Spokane	*35⅛	*35	*35	Oc. 1, Oc. 10	0.01
Simon Silver-Lead	N. Y. Curb	....	....	*6	...	...
Snowstorm Silver-L.	N. Y. Curb	...	...	*46	...	...
Tamarack-Custer	Spokane	1.40	1.40	1.40	Se. 30, Oc. 1, K	0.02
Tintic Standard	Salt Lake	3.47½	3.32½	3.47½	Se. 24, Se. 29	0.15
Utah-Apex	Boston	2⅜	2⅛	2⅛	June '23, Q, X	0.50
IRON						
Bethlehem Steel	New York	51½	48⅜	50½	De. 1, Ja. 2, Q	1.25
Char. Iron	Detroit	¾	¾	¾	...	...
Char. Iron pfd.	Detroit	1½	1½	1½	...	...
Colorado Fuel & Iron	New York	24⅛	23⅛	23½	No. 10, No. 26 Q	2.00
Col. Fuel & Iron pfd.	New York	...	...	102	Feb.' 23, Q	2.00
Gt. North'n Iron Ore	New York	31¼	29½	30	Apr. '23	1.00
Inland Steel	N. Y. Curb	...	...	46½	No. 15, De. 1Q	0.62½
Mesabi Iron	N. Y. Curb	...	...	5	...	...
Replogle Steel	New York	9⅞	9	9⅞	...	...
Republic I. & S.	New York	47½	44½	47⅜	May '21	1.50
Republic I. S. pfd.	New York	90½	90½	90½	Se. 15, Oc. 1 Q	3.75
Sloss-Sheffield S. & I.	New York	48	43½	47	Feb.'21,	1.50
Sloss-Shef. S. & I. pfd.	New York	...	...	75	Se. 2, Oc. 1, Q	1.75
U. S. Steel	New York	94⅞	92⅜	94½	No. 29, De. 29, Q	1.50
U. S. Steel pfd.	New York	120	118½	120	No. 4, No. 28, Q	1.75
Virginia I. C. & C.	New York	...	...	54	Je. 16, Jy. 2	2.00
Virginia I. C. & C. pfd.	New York	...	...	81	Je. 16, Jy. 2	2.50
VANADIUM						
Vanadium Corp.	New York	29½	27½	28⅜	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	40	39½	39½	Se. 29, Oc. 15 Q	1.00
Asbestos Corp. pfd.	Montreal	70	70	70	Se. 29, Oc. 15 Q	1.50
SULPHUR						
Freeport Texas	New York	11¼	10½	11½	Nov. '19, Q	1.00
Texas Gulf	New York	62½	59½	62½	Se. 1, Se. 15 Q	1.50
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	3½	3½	3½	...	...
MINING, SMELTING AND REFINING						
Amer. Metal	New York	45¼	44¼	45¼	No. 17, De. 1, Q	0.75
Amer. Metal pfd.	New York	...	...	110	No. 19, De 1, Q	1.75
Amer. Sm. & Ref.	New York	58½	55¼	58½	Oc. 11, No. 1, Q	1.25
Amer. Sm. & Ref. pfd	New York	96½	96½	96½	No. 9, De. 1,	1.75
U. S. Sm. R. & M.	New York	22	19½	22	Jan. '21, Q	0.50
U.S. Sm.R.& M. pfd.	New York	40	39¾	40	Oc. 8, Oc. 15, Q	0.87½

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Arthur E. Moysey; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Mines and Oil; Colorado Springs, Colorado Springs Stock Exchange.

NEW MACHINERY AND INVENTIONS

Device for Marking Tools

Tools easily stray from one part of a mine plant to another and become temporarily lost. Many times they are duplicated where there is no need of spending the money for them. If tools belong in a certain shop or department it should be required that they be returned to that place if removed. One method of keeping tools in their proper departments is to mark them with a mark designating the department in which they belong. An electrical device has been developed for this purpose. By attaching the pencil cord to the connection on the instrument and writing with an ordinary touch on the tool placed directly on the device it is possible to mark tools permanently. The instrument receives its operating current from any light socket that is convenient and as it weighs only twenty pounds it can be moved easily.

The device is made up in a portable aluminum box, inclosing an E-shaped core of laminated steel with a coil of proper size and turns on the center pole. The top of the box is of grid construction and serves as a surface plate. Spaces between the grid are filled with non-magnetic metal.

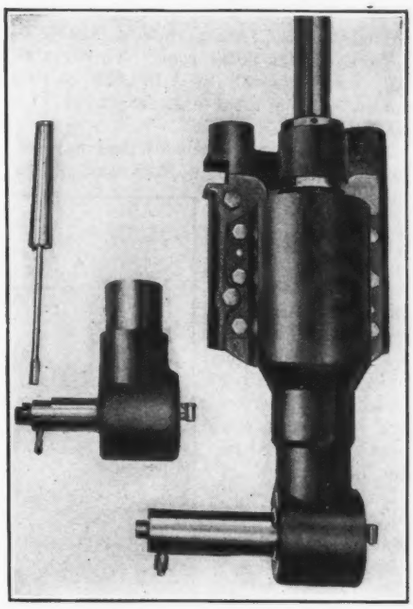
A secondary of heavy conductor is wound over the primary coil and is tapped in such manner as to produce a low voltage of high amperage. One end of the secondary is grounded to the surface plate while the tap is connected through a screw stud to a specially constructed copper pencil. The piece to be etched is laid on the surface plate and written on by the copper pencil as in ordinary writing. Regulation is automatically obtained by the reductance of the grid plate, which is part of the magnetic circuit.

This device is made by the Luma Electric Equipment Co., 405 Spitzer Building, Toledo, Ohio.

Electric etching pencil for writing on hardened steel

Drilling Attachment for Mine Repair Shops

A device which fits any standard press for the drilling, milling, countersinking, and counterboring of port holes and grooves in air tools, such as rock drills, pneumatic hammers, drills, and riveters, is particularly useful in mine repair shops, where tools of this nature are constantly appearing for repair. The attachment is constructed so that it is easily used for reaching inside the main bore, and drills or mills the vents or ports from the inside. With the use of the attachment it is possible to drill to a specified depth, to counterbore, or to mill circular, transverse or longitudinal slots. Because of the small space and comparatively long overhead in which these tools must work, there are no clearances, and the offset or horizontal arm is made as large as the bore of the air chamber and the depth of the drilling or milling will permit. This device is manufactured by the Harris Engineering Co., of Bridgeport, Conn.



Attachment for repairing rock drills

At right, a heavy-duty attachment mounted in special bracket on vertical slide of vertical milling machine. At left, another offset attachment with smaller arm for smaller work, which is interchangeable in special bracket with arm shown in bracket. Driving spindle is shown above. It has a taper shank fitted to machine spindle and at the lower end it is squared to drive the offset attachment.

To Build Large Turbines

The Pacific Gas & Electric Co. has awarded the contract for building three 33,000 hp. vertical reaction turbines at its Pit River No. 3 plant to the Pelton Water Wheel Co. These units will operate under a static head of 313 ft. and an average effective head of 280 ft. They will be of materially greater dimensions than any turbines so far installed in the West, the only units comparable with them in horsepower output being for considerably higher heads.

TRADE CATALOGS

Shovels—Bulletin 309 of the Marion Steam Shovel Co., Marion, Ohio, is devoted to a description of the Marion Model 21 electric and gasoline-electric ¾-yd. revolving shovels and cranes. It will be sent on request.

Four years ago the Marion company designed a type of excavator known as the gasoline-electric. This type was built as a follower of the steam machine in principle, having a motor for each operation of crowding, hoisting and swinging. This was to get away from the immense waste caused by using a straight gasoline shovel transmitting its power through clutches, gears, lines and frictions; in all such straight gasoline shovels somewhere round 40 per cent of the total available power is used up in overcoming transmission losses before any real effort is communicated to the excavating parts of the machine. So the Marion company decided on separate motors for crowding, hoisting, and swinging.

The Marion gasoline-electric shovel equipment consists of a main gasoline-engine driven generating set which maintains constant speed and power irrespective of the load on any or all parts of the operating mechanism. Current from this main set is supplied to the individual motors which control the three main motions of the machine.

By reason of the use of electrical transmission all power losses caused by the use of mechanical transmission are avoided and current is paid out to the main motions of the machine without any loss of energy. The motors, when completely overloaded, slow up and finally stall in the same way as the steam engine on a steam shovel.

The power of the gasoline-electric shovel is rather better than the power of the equivalent size steam shovel; its speed and handiness are many percent greater. Its tractive possibilities are practically unlimited; it requires no certificated operator; it requires no fireman. It is controlled as easily as a street car; it consumes gasoline as fuel, which is easily transportable. It uses no more than one pailful of water per day, and this only to make up evaporation loss; there is no danger of freezing in cold weather, for the radiator can be quickly and easily drained. All expense stops when the engine stops. It can be operated in inaccessible places where it would be impossible and impractical to attempt to take any other type machine.

Diamond Drills—The Sullivan Machinery Co., of Chicago, Ill., has just issued Catalog 80-0 (replacing Bulletin 69-0) which is entitled "Diamond Drilling for Oil." In it are described the advantages and methods used in boring for oil with Sullivan diamond core drills. Details of the drills and of the equipment used with them are given. The bulletin contains 54 pages. Accompany-

ing it is an illustrated pamphlet of 24 pages containing a reprint of an article entitled "Oil-Finding Up to Date," by Forest R. Rees.

Motors—"Electric Motors—How to Choose and Use Them" is the title of a 32-page booklet issued by the Reliance Electric & Engineering Co., of Cleveland, Ohio. It will be sent on request to those desiring it.

Stokers—A new model of multiple retort underfeed stoker is now being made by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. It is described in a 14-page catalog just issued by the company. Many distinguishing features in design and construction are claimed for the new stoker.

Diesel Engines — Fulton-Diesel engines made by the Fulton Iron Works Co., St. Louis, Mo., are covered in a new 32-page catalog sent out by the company. Besides describing the various parts of these stationary, vertical four-cycle engines (full Diesels) in detail, the catalog discusses the cycle of operation, fuel economy and consumption, fuel supply and other related topics.

Wrought Pipe—Seven accidents in which "National" wrought pipe, manufactured by the National Tube Co., Pittsburgh, Pa., made a remarkable showing, are described in an interesting little book entitled "Seven Wonders of Wrought Iron Pipe," published by the company.

Conduit Fittings—A folder of the Crouse-Hinds Co., Syracuse, N. Y., describes flanged "Obround Condulets," a type of conduit fitting made by the company.

Wattmeters—How much it costs to overcome the friction load in the plant; how much current is used at night; and what the maximum electrical demand is, are problems that the Esterline-Angus Co., Indianapolis, Ind., says (in a recent circular) can be solved by installing Esterline-Angus graphic wattmeters in the power circuit.

Compressors, Portable—Bulletin C-4 of the Curtis Pneumatic Machinery Co., St. Louis, Mo., describes a portable Curtis air compressor, which together with a Fordson tractor, forms a complete unit. The tractor is detachable and can be used for haulage purposes as desired.

Gears—William Ganschow, president of the William Ganschow Company, is editing a new handbook on gears and speed transformers, which will be combined with the forthcoming Ganschow general catalog No. 100. The purpose is to afford the user of gears and speed transformers easy access to formulas and data regarding design and use.

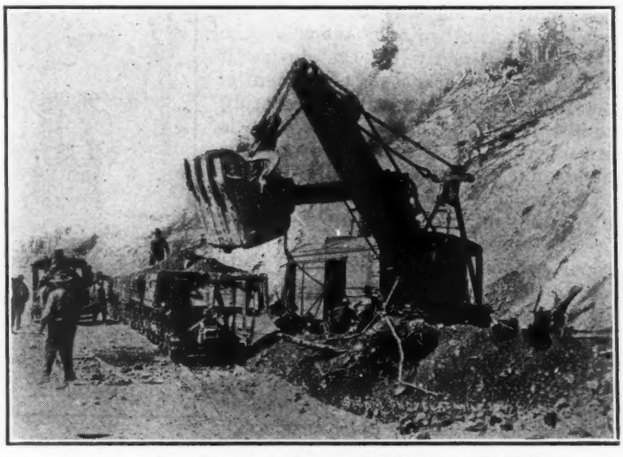
The Ganschow Handbook Catalog No. 100 is to be distributed gratis to all who use such materials as are made by the company. It will be sent to manufacturing executives upon request to the company at 1001 West Washington Boulevard, Chicago, Ill.

INDUSTRIAL NOTES

Marion Shovels Used on the Alaska Railroad

More than 17,000,000 cu.yd. of material were moved in the construction of the Alaska Railroad, which was completed last spring. Of this amount, 7,348,256 cu.yd. was of common dirt; 1,291,777 cu.yd. was loose rocks; 3,035,755 cu.yd. was frozen rock, and 4,894,563 cu.yd. was solid rock. This material, with a swell of 1,123,820 cu.yd., completed the total excavation of 17,694,171 cu.yd.

Three Marion shovels formed part of the equipment used in this excavation. All three of them were veterans of former construction work when they began to win the right of way for the Alaska Railroad. The smallest of the three, a Marion "40" with a 1½-ton bucket, belonged to the old Alaska Northern Railroad, which was purchased by the Alaskan Engineering Commission. The other two, of the Marion "60" type with 2½-ton buckets, helped dig the Panama Canal and were then shipped to Alaska. Their sturdiness was amply illustrated by their continuous use, after years of prior service, in moving dirt and rock during all of the construction period.



Steam shovel at work on Anchorage Division of Alaska Railroad

Oliver Company Buys Filter Patents

Colorado Iron Works Co., Denver, Colo., have sold their filter patents to the Oliver Continuous Filter Co. and have discontinued the manufacture of the Portland filter. This transaction does not affect any of their other business nor the supply of repairs for Portland filters manufactured by them.

E. L. Garihan New Sales Manager

Edward L. Garihan, for a number of years connected with the Bethlehem Steel Co. in different capacities, and also sales manager of the Tioga Steel & Iron Co., has been appointed sales manager of the Chrome Steel Works, Carteret, N. J.

Mammoth Redwood Tank Shipped

The Redwood Manufacturers Co. (1600 Hobart Building, San Francisco) recently shipped to the Mesabi Iron Co., Babbitt, Minn., within ten days of the receipt of the order, the material for a mammoth 3-in. stave redwood tank, 100 ft. diameter by 14 ft. stave height, equipped with inside overflow launder. The tank, the largest of its kind ever constructed, will be equipped with the patented thickener mechanism supplied by The Dorr Co., of New York.

A Famous Instrument Maker

The brief sketch of the career of Christian Louis Berger, the founder of the house of C. L. Berger & Sons, which is given in an attractive leaflet recently issued by that company, should interest many engineers who have long been familiar with the surveying and other engineering instruments made by this well-known concern. Mr. Berger, it says, had in a high degree that faculty of genius which consists of "the infinite capacity for taking pains." His genius was inherited, as well as acquired. He was born in Stuttgart, Wurttemberg, Germany, in 1842. His grandfather was Court Armorer of the kingdom, and left the smithy to Mr. Berger's father. It is still conducted by the family.

At the age of fourteen the lad expressed the extraordinary determination to become a mechanician of the fine mechanic arts, and planned to obtain the most comprehensive education that he could secure in Europe, and then to establish himself permanently in America, whose mechanical possibilities he foresaw.

The men and firms he worked for and with for fifteen years in Germany and England, and later in America (such as Christian Saeger, of Stuttgart and his son; G. Schubard, of Marburg; J. Lohmeyer and A. & G. Repsold, of Hamburg; Cook & Sons, of York, England; E. S. Ritchie, of Brookline; John Upham, of Boston), were the world masters in their profession at that time.

In 1871 Mr. Berger carried out his long-cherished plan by establishing in Boston, in one small room, the beginning of the present company. "How he succeeded, America and the world know," says the leaflet. "He was known among his contemporaries as 'the dean of the surveying and engineering instrument making profession'."